TC425S8T36 2002c.2

SANTA CLARA VALLEY WATER DISTRICT
LIBRARY
5750 ALMADEN EXPRESSWAY
SAN JOSE, CALIFORNIA 95118

ALTERNATIVES ANALYSIS REPORT
FOR
STEVENS CREEK
DROP STRUCTURE MODIFICATION
UPSTREAM OF HIGHWAY 85
PROJECT NO. 102901

Existing Drop Structure Facility at Stream Gage Station 35 in the City of Mountain View, Santa Clara County, California

Prepared by:

Bobby Tan
Assistant Engineer
Capital Program Services Division

and

Gordon Lau, P.E.
Project Engineer
Capital Program Services Division

April 2002

Rev	Comments	Originator	Checker	PM	SPM	Date
0	Revised Alternative Analysis Report	B. Tan	Lau	Lau		5/1/02

TABLE OF CONTENTS

Page

1.0 PROJECT SUMMARY 1
  1.1 INTRODUCTION 1
  1.2 BACKGROUND 1
  1.3 PROJECT OBJECTIVES 1

2.0 DESIGN CRITERIA 2
  2.1 DESIGN CRITERIA 2
    A. Discharge Data 2
    B. Hydraulic Constraints 2
    C. Environmental and Biological Constraints 2
    D. Design Considerations 3

3.0 ALTERNATIVES 6
  3.1 ALTERNATIVE NO. 1—NO PROJECT 6
  3.2 ALTERNATIVE NO. 2—DENIL FISH LADDER 6
  3.3 ALTERNATIVE NO. 3—VORTEX ROCK WEIR 7
  3.4 ALTERNATIVE NO. 4—CONCRETE VORTEX WEIR 7
  3.5 ALTERNATIVE NO. 4(a)— REFINED CONCRETE VORTEX WEIR 8
  3.6 ALTERNATIVE NO. 5—CONCRETE HORIZONTAL WEIR 8
  3.7 ALTERNATIVE NO. 6—BOULDER WEIR AND RETAINING WALL 8

4.0 EVALUATION AND RECOMMENDATION 10
  4.1 EVALUATION CRITERIA 10
  4.2 ALTERNATIVES ANALYSIS 10
  4.3 RECOMMENDATION 13

REFERENCES 16

TABLE

ALTERNATIVE COMPARISON SUMMARY

APPENDICES

APPENDIX A—Map and Photos
  A1 Location Map
  A2 Stream Gage Station 35 Adjacent to Pedestrian Trail
  A3 Channel Invert By Highway 85
  A4 Existing Drop Structure Facility
  A5 Upstream Concrete Weir

APPENDIX B—Preliminary Drawings and Sketches
  B1 Preliminary Plans (Submitted to CDFG in 1999 for Review)
  B2 Denil Fish Ladder Alternative
  B3 Vortex Rock Weir Alternative
  B4 Concrete Vortex Weir Alternative
  B4(a) Refined Concrete Vortex Weir Alternative
  B5 Concrete Horizontal Weir Alternative
  B6 Boulder Weir and Retaining Wall Alternative

APPENDIX C—Cost Estimates
  Table 1—Construction Cost for Proposed Projects
  Table 2—Total Project Cost Comparison

1.0 PROJECT SUMMARY

1.1 INTRODUCTION

This report presents the results of the Alternatives Analysis Study for the proposed Stevens Creek Drop Structure Modification Upstream of Highway 85 Project. The objective of the study is to evaluate alternatives for the proposed project and recommend an alternative that meets all project objectives. The project site is located on Stevens Creek at Stream Gage Station 35 (Station 35), between the Central Avenue pedestrian bridge and the Highway 85 bridge crossing in the city of Mountain View. Additional information for the vicinity of the site is shown in the Location Map in Appendix A.

1.2 BACKGROUND

As part of the Stevens Creek Flood Control Project completed in 1983, three fish ladders were constructed at Moffett Boulevard (Moffett), Evelyn Avenue (Evelyn), and Fremont Avenue (Fremont). In July 1995, the Santa Clara Valley Water District (District) hired a consultant to evaluate the effectiveness of the fish ladders. The findings from the study showed that the Moffett and Fremont fish ladders did not function as desired. The Moffett site had insufficient flow depths while the Fremont site had acute accumulation of sediments. The Evelyn fish ladder had no problems.

In January 1998, the District revisited the problems at the Moffett and Fremont fish ladders. A site visit with the California Department of Fish and Game (CDFG) confirmed the problem, and implementation of design improvements for the Moffett and Fremont fish ladders was initiated. The first indication of a fish passage problem at Station 35 was encountered during this site visit. CDFG expressed concern that the existing drops below the gage station appeared to be too high for fish to pass. In July 1998, the District sent CDFG the proposals to remedy the problem at all three sites (Moffett, Fremont, and Station 35). Only proposals for the Moffett and Fremont sites were accepted and modifications to those sites were completed in November 1998. Remedying the problem for Station 35 required further study and environmental evaluation. Based on this, the District initiated the present project.

Fisheries scientists working as part of the Fisheries and Aquatic Habitat Collaborative Effort (FAHCE) Technical Advisory Committee (TAC) compiled the existing information on limiting factors adversely impacting the availability and suitability of steelhead habitat within Stevens Creek. Based on results of the limiting factors analysis, TAC recommended remediation of fish passage barriers on Stevens Creek. Station 35 was identified as an impediment to the upstream migration of steelhead, restricting access to suitable spawning and juvenile-rearing areas located further upstream within Stevens Creek. Construction of a new fish passage facility at Station 35 will compliment the comprehensive fisheries efforts currently underway as part of the FAHCE process to improve overall habitat conditions.

1.3 PROJECT OBJECTIVES

The objective of this project is to provide a fish passage facility on Stevens Creek at Station 35 to improve the upstream and downstream migration of steelhead. The fish passage facility shall not adversely affect the flood protection capacity of the existing creek.

2.0 DESIGN CRITERIA

2.1 DESIGN CRITERIA

A. Discharge Data

1. *Design Flow Rate*

The proposed Stevens Creek 100-year discharge is 235 cubic meters per second (8,300 cubic feet per second [cfs]), and the average velocity is expected to be 4.6 meters per second (15 feet per second) over the weirs, just upstream from Highway 85 under current conditions.

2. *Flow Rate at Ordinary High Water (2.33-Year Event)*

$Q_{2.33}$ = 75 cubic meters per second (2,650 cfs), water depth = 2.74 meters (9.0 feet).

B. Hydraulic Constraints

1. *Upstream Foot Bridge*

The Central Avenue Pedestrian Bridge low chord elevation at the center of the bridge span is 22.22 meters (72.90 feet)[1] The water level of the 1 percent flood shall be limited to below this elevation.

2. *Flow Pattern in the Drop Structure*

The existing drop structure shall be replaced by a stepped facility that allows for fish passage as well as dissipating the flow energy and containing the transitional flow profile to prevent erosion to the downstream sections.

3. *Downstream Highway 85 Bridge*

The Highway 85 Bridge has a low chord elevation of 21.42 meters (70.30 feet). The maximum water surface level at the bridge should be well below this elevation for safety reasons.

---

[1] For all elevations, the District's benchmark BM146 was used as the project's basis of elevation. The datum used is National Geodetic Vertical Datum 1929. BM146 elevation is 21.363 meters (70.088 feet).

C. Environmental and Biological Constraints

1. *U.S. Army Corps of Engineers, California Department of Fish and Game, and Regional Water Quality Control Board Permits*

This project will require either a U.S. Army Corps of Engineers (Corps) Nationwide Permit or an Individual Corps 404 Permit, the CDFG 1601 Streambed Alteration Agreement permit, and the Regional Water Quality Control Board 401 Certification or Waiver. An environmental consultant will be retained to perform the necessary environmental tasks. Design staff will work with the environmental consultant to determine the permit requirements for the project and assist the consultant in the permit application process.

2. *California Environmental Quality Act and the Migratory Bird Treaty Act*

Design staff and the Lower Peninsula/West Valley Watershed Support Unit will assist environmental consultant in preparation of all necessary California Environmental Quality Act documents and permits. Additionally, the policies and guidelines of the Migratory Bird Treaty Act will be addressed.

3. *Biological Constraints*

The project shall minimize impact to the riparian habitat. The facility shall consider a jump height of 0.305 meter (1 foot) or less for fish passage. The target species in the Stevens Creek is steelhead. The facility shall accommodate 90 percent of the range of flows during the migration season.[2]

D. Design Considerations

1. *Height of Drop Structure*

The height of each drop of the fish passage facility shall be limited to 0.305 meter (1 foot).

2. *Energy Dissipation*

- Denil Fish Ladder

  Because fish need to constantly swim while in a Denil fishway, resting pools are required between long segments and are typically placed every 9.1 meters (30 feet). Dimensions for the pools are approximately 4.9 meters (16 feet) long, 3.1 meters (10 feet) wide, and 0.91 meter (3 feet) deep.[3]

---

[2] Flosi, *California Salmonid Stream Habitat Restoration Manual*, 1998.

[3] Katopodis, *Introduction to Fishway Design*, 1992.

- Vortex Weir

  Vortex weirs shall have scour pools immediately downstream of each weir or structure. The V-shape of the vortex weirs should effectively concentrate the flow in the middle. The capacity of the weir facility for energy dissipation and fish passability shall be designed in accordance with the CDFG restoration design manual.

- Horizontal Weir

  The hydraulics of the horizontal weir structure is similar to that of the step-and-pool fishways where the two flow regimes are plunging flow and streaming flow. The limitation for the step-and-pool fishways is their narrow range of operating flow when no other flow control is provided.[4] In our case, low flows from the channel shall be concentrated through a V-notch in the middle of the weir. Again, the weir facility shall be designed in accordance with the CDFG restoration design manual.

3. *Sediment Sluicing*

The existing drop structure has been observed to trap little sediment. Facilities similar in design to the existing drop structure shall be used to prevent sediment deposition. See next page for *In-Stream and In-Fish Ladder Velocity, and Sediment Transport Characteristics table*.

4. *Stream Gage Station 35*

The existing stage recorder housing shall be relocated to the south bank, opposite from the Stevens Creek Trail, and located upstream from the most upstream weir. In all instances, the channel lining where the stage recorder housing is embedded shall be constructed of reinforced concrete.

5. *Soil Conditions*

From archived geotechnical report by the District's consultant, the maximum dry density of the soil is 1.75 grams per cubic centimeters (109.1 pounds per cubic feet [pcf]); the maximum wet density of the soil is 2.05 grams per cubic centimeters (128.2 pcf).[5]

---

[4] Bates, *Fishway Design Guidelines for Pacific Salmon*, 1997.

[5] Berlogar, Long & Associates, *Geotechnical Investigation Proposed Stevens Creek Flood Control Improvements Central Expressway to San Francisco Bay*, December 1981.

In-Stream and In-Fish Ladder Velocity and Sediment Transport Characteristics					
Representative Flow Condition	**Flow Rate**	**$V_{Upstream\ Channel}$**	**V_{Weir}**	**D_C**	**D_{50}**
20% Exceedence Fish Migration Flow	25 cfs	3 fps	3 fps	5.4 mm	6 mm
10% Exceedence Fish Migration Flow	50 cfs	4 fps	4 fps	6.7 mm	6 mm
2.33-year Flood Flow	2650 cfs	5 fps	7 fps	29.5 mm	6 mm
10-year Flood Flow	4900 cfs	5 fps	9 fps	33.1 mm	6 mm
100-year Flood Flow	8300 cfs	5 fps	10 fps	32.8 mm	6 mm

$V_{Upstream\ Channel}$ = Mean velocity for the upstream channel taken approximately 40 meters (130 feet) upstream from the proposed fish ladder facility.

V_{Weir} = Mean average velocities passing through the pool area of the weirs.

DC = Diameter of particle corresponding to initiation of motion under the V_{Weir} condition.

D_{50} = Median diameter of sediment observed in the field.

Conclusions:

1. During the fish migration period or flood flows, the sediment transported in the stream will be sluiced through the fish ladder as indicated by the fact that V_{Weir} is greater than $V_{Upstream\ Channel}$.
2. The flood flows, even for the 2.33-year flood, is 2 orders of magnitude larger than the fish migration flow. Sediment sizes greater than D_{50} are not moved during the fish migration season.

3.0 ALTERNATIVES

Based on the design data and criteria described in Section 2.0, a total of seven alternatives, in addition to the no-project option, were developed. They are described in the following.

3.1 ALTERNATIVE NO. 1—NO PROJECT

Under this alternative, there would be no improvements to the existing facility. The drop structure, as well as the existing gage station, will remain in the current location. The existing concrete facility consists of one drop that is approximately 1.06 meters (3.5 feet) high and two horizontal weirs with a low-flow notch at the center of each weir. As such, the existing facility will impede the upstream migration of steelhead and other fish species. The existing riparian habitat includes Elderberry, Locust, Buckeye, Walnut, Oak, Cottonwood, and others as identified in the preliminary drawings and sketches in Appendix B. The existing sacked concrete invert section just upstream from the Highway 85 bridge experienced severe scouring and would continue to scour if not repaired. The 1 percent water surface elevation at the pedestrian bridge was computed to be 22.26 meters (73.04 feet), which is above the bridge low chord elevation at the center and may damage the bridge as well as human lives.

The implementation cost of the no-project alternative is, by definition, zero. However, there would be some costs to the District associated with maintenance of the site. The annual maintenance cost is approximately $5,000 for inspections and debris removal.

3.2 ALTERNATIVE NO. 2—DENIL FISH LADDER

In this alternative, the existing facility would be partially demolished to accommodate a Denil fish ladder built out of concrete with steel baffles. The new fishway will be constructed on the south side of the creek opposite of the Stevens Creek Trail. It will be constructed parallel to the channel and alongside the existing drop structure. The existing gage station will be relocated to a new location on the south bank. The relocated area was chosen to avoid construction work on the Stevens Creek Trail. The Denil fish ladder will consist of two segments that are 9.1 meters (30 feet) long and two resting pools that are 4.9 meters (16 feet) in length and 3.1 meters (10 feet) in width. The depth of both pools is 0.91 meter (3 feet). Since the length of a typical Denil fishway rarely exceeds 9.1 meters, a resting pool is required between two long segments. Therefore, two resting pools will be required and located before each consecutive segment. The first segment (Denil 1) will have a slope of 22.5 percent and the second segment (Denil 2) will have a slope of 14.4 percent, both of which are within the ranges of 10 to 25 percent for a Denil fishway. This alternative will require a right of entry agreement between the District and the City of Mountain View for construction access. No trees will be removed for this alternative. See Appendix B2 for preliminary drawings and sketches of the Denil Fish Ladder alternative.

The total project cost, based on year 2002 cost, is $1,395,200. This amount does not include the $15,000 estimated for annual maintenance work. Refer to Tables 1 and 2 in Appendix C for the breakdown costs for Alternative No. 2.

3.3 ALTERNATIVE NO. 3—VORTEX ROCK WEIR

This alternative would involve demolishing the existing facility and constructing a grouted rock channel lining with a series of vortex rock weirs. The distance from weir to weir would typically be 7.2 meters (24 feet) apart. Boulders having 1.22 meter-diameter (4-foot diameter) will be used to build vortex rock weirs, and 0.61 meter-diameter (2-foot diameter) boulders will be used for scour pool lining between the rock weirs. The pools below each weir was selected to be 2 meters (6.6 feet) deep. Each drop from weir to weir will be no more than 0.36 meter (1.2 feet). The extent of this alternative will require removal of approximately 20 trees, of which 10 are native trees. There will be replanting of trees to compensate for the tree removal. The mitigation ratio for nonnative trees removed is 1:1 while native trees removed are replaced with 3:1. This alternative will require permanent closure of the Stevens Creek Trail due to left and right bank expansions as a result of flatter slopes, since the existing side slopes of 1:1 are very steep.

For construction access, a right of entry agreement is also needed from the City of Mountain View. The existing gage station will be relocated adjacent to the upstream new concrete weir dam foundation on the south side of the creek, opposite of the Stevens Creek Trail. See Appendix B3 for preliminary drawings and sketches of the Vortex Rock Weir Alternative. The relocated area was chosen to avoid trenching work or to minimize altogether construction activities on the Stevens Creek Trail. In order for the gage station to function properly and accurately, the most upstream weir and side channel will be constructed of concrete due to the presence of the communication pipes, which extends out and in parallel with the flow. The existing top piece of the recorder housing from the flanged connector will be salvaged and the bottom piece will be cut to below grade and filled with backfill. The salvaged housing will be connected to a new corrugated steel pipe housing at the proposed relocation.

The total project cost, based on year 2002 cost, is $1,836,500. This amount does not include the $5,000 estimated for annual maintenance cost. Refer to Tables 1 and 2 in Appendix C for the breakdown costs for Alternative No. 3.

3.4 ALTERNATIVE NO. 4—CONCRETE VORTEX WEIR

This alternative is similar to Alternative No. 3 except that the vortex weirs and channel lining are constructed of concrete. Unlike the vortex rock weir alternative, right of way agreements for channel bank widening is not required and the new structure can be constructed even if the existing slopes are 1:1. Most importantly, the Stevens Creek Trail remains without the need for permanent closure. Again, a right of entry agreement between the District and the City of Mountain View is needed for construction access. The existing gage station will also be relocated to the same location as Alternative No. 3. The distance from weir to weir will be 7.2 meters (24 feet) apart. The pools below each weir are 2 meters (6.6 feet) deep. The hydraulic slope along the weirs would be 5 percent. Each drop from weir to weir will be 0.36 meter (1.2 feet). This alternative would require the removal of one existing native (Elderberry) and ten nonnative trees. There will be replanting of trees. The ratio for nonnative trees removed is 1:1 and for native trees 3:1. See Appendix B4 for preliminary drawings and sketches of the Concrete Vortex Weir Alternative. This design has been reviewed and approved by CDFG.

The total project cost, based on year 2002 cost, is $1,711,500. This amount does not include the $5,000 estimated for annual maintenance cost. Refer to Tables 1 and 2 in Appendix C for the breakdown costs for Alternative No. 4.

3.5 ALTERNATIVE NO. 4(a)— REFINED CONCRETE VORTEX WEIR

This alternative is identical to Alternative No. 4 except that there are four weirs instead of five weirs in the previous alternative. As a result of the shortened hardscape and reduce number of pools, the drop from weir to weir is 0.27 meter (0.88 feet). There is no need for channel widening as the channel side slopes will be 1:1 and the Stevens Creek Trail won't be affected. However, a right of entry agreement between the District and the City of Mountain View is still needed for construction access. The existing gage station will be relocated on the east bank, like in the previous alternatives. The distance from weir to weir will be 7.2 meters (24 feet) apart. The pools below each weir varies from 1.2 meters (4 feet) to 1.26 meters (4.13 feet) deep. The slope along the channel invert is approximately 4 percent. This alternative would require the removal of existing native (Elderberry) and seven nonnative trees. The same ratio for mitigation would be similar as the previous alternative. See Appendix B4(a) for draft construction drawings of the Refined Concrete Vortex Weir Alternative.

The total project cost based on year 2002 cost, is $1,606,500. This amount does not include the $5,000 estimated for annual maintenance cost. Refer to Tables 1 and 2 in Appendix C for the breakdown costs for Alternative No. 4(a).

3.6 ALTERNATIVE NO. 5—CONCRETE HORIZONTAL WEIR

This alternative consists of five horizontal weirs and pools replacing the existing drop structure. A low-flow triangular notch is provided at the center of each weir. The weirs and channel lining are all made of concrete. The channel width conforms to the existing channel structure, varying from 5 meters (16.4 feet) at the most downstream pool to 6.5 meters (21.3 feet) at the most upstream pool. The pool depth is 0.86 meter (2.8 feet) for all pools. The depth of the notch is 0.305 meter (1 foot) and the width is 0.61 meter (2 feet) at the weir surface. Again, the distance from weir to weir will be 7.2 meters (24 feet) apart. The drop between consecutive weirs is 0.23 meter (0.76 feet), in which the hydraulic slope from the second plunge pool starting at the downstream end to the most upstream plunge pool is 3.22 percent while the most downstream plunge pool is at 1.11 percent. This design has been reviewed and approved by CDFG.

Like Alternative Nos. 2, 3, and 4, this alternative would require demolishing the existing drop structure facility and relocating the existing gage station over to the opposite bank. This alternative will require a right of entry with the City of Mountain View for construction access. Approximately 11 trees will be removed, of which 1 tree is native. There will be replanting of trees. The mitigation ratio for nonnative trees removed is 1:1 while native trees removed are replaced with 3:1. See Appendix B5 for preliminary drawings and sketches of the Concrete Horizontal Weir Alternative.

The total project cost, based on year 2002 cost, is $1,691,500. This amount does not include the $5,000 estimated for annual maintenance cost. Refer to Tables 1 and 2 in Appendix C for the breakdown costs for Alternative No. 5.

3.7 ALTERNATIVE NO. 6—BOULDER WEIR AND RETAINING WALL

This alternative consists of five vortex rock weirs and a concrete retaining wall that supports lateral earth pressures on both sides of the channel. Unlike Alternative No.4, Concrete Vortex Weir, the channel lining consist of 1.22 meter (4 feet) diameter rocks that are placed along the 4 meter (13.1 feet) invert width and 1.5:1 (horizontal/vertical) side slopes. Similar diameter-sized rocks will be placed on top of the riprap lining for the vortex weirs. Throughout the length of the lining, retaining walls on both sides of the channel stand vertically for approximately 4.3 meters (14.1 feet) and then angles outward to existing top of bank at 1:1 side slopes. The angle portion at the top of the retaining wall also functions as a concrete channel lining and is the location where the ends of vortex rock weirs stop. The distance from weir to weir is 7.2 meters (24 feet) and the depth of the pools is 0.9 meters (3 feet). The drops from weir to weir are 0.23 meters (0.75 feet). The existing gage station will be relocated to the opposite (east) bank. Eleven trees will be removed and mitigated with ratios of 1:1 and 3:1 for nonnative and native trees, respectively. See Appendix B6 for preliminary drawings and sketches of the Boulder Weir and Retaining Wall Alternative.

The total project cost based on year 2002 cost is $2,791.500. This amount does not include the $5,000 estimated for annual maintenance cost. Refer to Tables 1 and 2 in Appendix C for the breakdown costs for Alternative No. 6.

4.0 EVALUATION AND RECOMMENDATION

4.1 EVALUATION CRITERIA

The criteria for evaluating the alternatives are described in the following:

- Fish Passage
- Hydraulics and Sediment Transport—Can the new facility provide for adequate energy dissipation and contain the design flow rate within the structure basin?
- Past Problems or Experience—Research and review lessons learned from other projects.
- Environmental Impacts on the Riparian Habitat
- Aesthetics
- Estimated Cost
- Annual Maintenance Cost/Maintenance Level

4.2 ALTERNATIVES ANALYSIS

Alternative No. 1—No Project requires no improvement to the existing facility. The three drops, particularly the middle drop with a jump height of 1.06 meters (3.5 feet), are too high for fish to pass. With no improvements, the no-action alternative would significantly impact the fish habitat by preventing fish migration. This alternative does not meet project objective and, therefore, is not recommended.

Alternative No. 2—Denil Fish Ladder has been used in several of the District's creeks, including the fish ladders at Moffett, Evelyn, and Fremont sites. As discussed in the introduction, the Moffett and Fremont sites did not function as desired and required modification. However, in spite of past experience with Denil fish ladders, listed below are the advantages:

1. The energy of water passing through the structure is dissipated in turbulence caused by baffles, which leave a narrow zone of low-velocity flow.
2. The Denil fish ladder allows a larger range of flow than the other fishways (Alaskan Steep-Pass, Weir, Vertical Slot, and Culvert) and, therefore, has a greater fish attraction capability.[6]
3. The fish ladder can be installed at steeper slopes and, for a given height of obstruction, can be substantially shorter in length.

---

[6] Katopodis, *Introduction to Fishway Design*, 1992.

The Denil fish ladder can be very efficient at passing sediment, which may otherwise block other types of fishways as mentioned above. However, the baffles can easily catch floating debris, resulting in partial or complete blockage. There are also past problems associated with Denil fish ladders at the Fremont and Moffett sites on Stevens Creek. The fish ladders at these sites did not function properly under low-flow conditions and, overtime, sediment accumulation occurs. The Denil fishway requires regular maintenance work during fish migration season to ensure clear passage, unlike the weir structures that are self-maintaining under most circumstances. The annual cost to maintain the facility is estimated to be $15,000, which includes inspections and twice yearly maintenance work. This alternative relies more on site-specific conditions. The local flow pattern, just downstream from a mild bend, makes designing a low-flow channel along the south bank difficult. In view of past problems associated with Denil fish ladders along the Stevens Creek and the specific site conditions, this alternative is not recommended.

Alternative No. 3—Vortex Rock Weir with rock channel lining provides a more natural-looking fish ladder. The boulders are suited for diversifying flows because they are resistant to being displaced by high flows. These boulder structures are used to break up or diversify stream flow in a particular stream reach. Constructing a vortex rock weir fish ladder has several advantages:

1. Vortex weirs require less maintenance for sediment removal due to the high level of turbulence in the scouring pools, keeping the sediment in suspension. Scouring pools, in turn, provide resting spots for fish habitat.

2. Vortex weirs act as grade control structures.

3. The V-shape of the vortex weirs concentrates the flow in the center of the creek, allowing for improved sediment transport during low flows.

For this alternative, the channel banks will be lined with grouted rock riprap. According to Caltrans, the recommended slope for a rock slope protection is 1.5:1 or flatter.[7] Hence, in order to accommodate milder side slopes, the existing channel banks will need to be widened, resulting in relocation or permanent closure of the Stevens Creek Trail near the Highway 85 overpass. The existing channel has a maximum channel bank slope of approximately 1:1 and a depth of 4 meters (13 feet). The new grouted rock slope will be approximately 1.5:1 and as such, a total of 20 trees will be removed. Existing chain link fences on both sides of the bank will also be removed and relocated further away from the channel.

Selecting proper rock sizes and positioning the rocks during construction requires care. There is a concern of incorporating a rock weir system immediately upstream from a bridge crossing, especially a freeway bridge. As an example, on a recent trip to vortex rock weir sites in Northern California, the possibility of boulders moving out of place was confirmed. It was revealed that a huge boulder had separated from the footer rocks and was later repositioned into place by heavy machinery. For this alternative, a distance of 0.91 meter (3 feet) separates the gap between the bridge supports to the nearest boulder. Therefore, because of the permanent closure to the Stevens Creek Trail due to channel bank widening, and the risk of boulders moving out of place, this alternative is not recommended.

---

[7] California State Department of Transportation, Internet Website, *Highway Design Manual*.

Alternative No. 4—Concrete Vortex Weir has the same advantages described above for the vortex rock weirs. However, the concrete vortex weir does not have the same constraints as from the vortex rock weir alternative. The existing channel configuration (i.e., steep 1:1 slopes) is acceptable. More importantly, there is no need for channel bank widening and the Stevens Creek Trail can remain without permanent closure. This alternative has the second highest project cost, and the deep 2-meter (6.6-foot) pools and extended V-shaped vortex weirs to the top of the basin would require more excavation and concrete amount to reduce the water surface elevation to the same safe existing levels. In terms of project aesthetics, the concrete vortex weir structure will tend to be highly visible by its deep pools and extending weirs. Hydraulic analysis results showed that the backwater generated by the vortex weirs during a 1 percent flood would exceed the Central Avenue Pedestrian Bridge walkway elevation and may cause damage to the bridge and impact the safety of the public. Therefore, because Alternative No. 4 does not meet the objective of reducing the flood water levels, this alternative is not recommended.

Alternative No. 4(a)— Refined Concrete Vortex Weir has four weirs instead of five weirs, which will reduce the amount of concrete needed. Additionally, there is less impact to the environment due to the fewer trees removed and excavation amounts. The existing channel configuration with 1:1 side slopes and 1.5:1 transitional wing wall at the upstream end of the concrete lining will have no effect to the Stevens Creek Trail (i.e., no permanent closure). The depth of the pools are not as deep as the previous alternative, which are 2 meters (or 6.6 feet). This alternative is based on the original concrete vortex weir that was reviewed by CDFG staff. Significant sediment problems are not expected as the pools are self-maintaining with only minor maintenance needed. The four vortex weirs and plunging pools will be as effective as the previous alternative, in which it is based on. This will be suitable for fish migration. The Refined Concrete Vortex Weir - Alternative No. 4(a) is recommended because it meets the project objective and is selected based on the Alternative Comparison Summary, see chart on pages 14 and 15.

Alternative No. 5—Concrete Horizontal Weir with a triangular notch is able to contain the flow within the concrete basin with 0.86-meter (2.8-foot) deep plunge pools and a channel bottom conforming to the existing channel width. The results from the hydraulic analysis study[8] using the HEC-2 program shows that the 1 percent water surface elevation at the Central Avenue Pedestrian Bridge is below the bridge low chord at the abutments while providing a freeboard of approximately 0.61 meter (2 feet) at the center span. Since this design requires similar excavation and concrete amounts than the refined concrete vortex weir alternative, due to shallow pools to compensate for one less weir and pool, an apparent benefit is decreased construction cost and minimal disturbance to the existing creek. However, the concrete horizontal weir may not have the advantages of the vortex weir alternatives. Therefore, this alternative is not recommended.

Alternative No. 6—Boulder Weir and Retaining Wall from a economical standpoint, is the most expensive to build when compared to all the alternatives presented in this analysis report. This alternative is more feasible to the vortex rock weir alternative because it does not require channel widening and consequently have any effect on the Stevens Creek Trail. However, due to the complexity and extensive use of boulders in this structure, large excavation amounts and channel embankment work would cause more disruption and impact to the natural surroundings than the other alternatives. As such, construction costs will most certainly play a role in the benefit to cost dilemma. It has the traits of a vortex weir concept but is not recommended because of the above reasons since other alternatives provide a suitable option at a lower cost. The Boulder Weir and Retaining Wall alternative is highly visible and unique in terms of aesthetics.

---

[8] Please refer to Stevens Creek Fish Ladder project file binder (Design Volume 4).

4.3 RECOMMENDATION

As shown in the Alternative Comparison Summary, the seven alternatives were compared using the criteria listed in Section 4.1. These criteria include fish passage, past problems or experience, environmental impacts, aesthetics, annual maintenance cost and maintenance level, and total project costs. After comparing these criteria for all seven alternatives, **Alternative No. 4(a)— Refined Concrete Vortex Weir** is recommended because it meets all the project objectives, is highly passable for steelhead, has minor mitigable environmental impact, has no need for channel widening or deepening, requires little or no maintenance, original concept has been reviewed with CDFG staff, and protects against the 1 percent flow for public safety. For these reasons, staff recommends replacing the existing drop structure with the four concrete vortex weir structure on Stevens Creek at Station 35 in the city of Mountain View.

ALTERNATIVE COMPARISON SUMMARY

Criteria	**Alternative No. 1** **No Project**	**Alternative No. 2** **Denil Fish Ladder**	**Alternative No. 3** **Vortex Rock Weir**	**Alternative No. 4** **Concrete Vortex Weir**
Fish Passage	Existing obstacles remain	Provides for most passage	Highly reliable passage	Highly reliable passage
Past Problems or Experience	Existing facility continues to impede fish migration	Not effective in the past; Relies more on site-specific conditions	High risk for rock separation	No significant problems expected
Environmental Impacts	None	None	Twenty (20) trees removed and closure of Stevens Creek. Trail due to channel widening	Eleven (11) trees removed
Aesthetics	Existing concrete structure remains	Somewhat visible, new fishway with steel baffles	Highly visible, natural-looking rocks and riffles	Highly visible, stands out more than existing facility and Alternative No. 5
Estimated Costs -Construction -Planning, Admin, Design, R/W, etc. -Total Project Cost	Zero project cost although annual maintenance cost would still apply	$ 740,000 655,200 $1,395,200	$1,100,000 736,500 $1,836,500	$1,020,000 691,500 $1,711,500
Annual Maintenance Cost/Maintenance Level	$5,000/ Exist maintenance level	$15,000/ High maintenance	$5,000/ Minor maintenance	$5,000/ Minor maintenance
Summary	Not selected because it does not meet project objectives for fish passage and improving the upstream and downstream migration of steelhead.	Not selected because of high maintenance and past fish passage problems associated with Denil fish ladders. Since it relies more on site-specific conditions to function properly, it is difficult to design or model for it to be a success. This alternative would also require twice-a-year maintenance which is costly and performed on a periodic basis.	Not selected because of second highest project cost, high risk for rock separation*, requires more excavation for deep plunge pools and closure of the Stevens Creek Trail even though it meets the project objective for fish passage.	Not selected because of third highest project cost, pool volume less than in horizontal weir alternative pools due to smaller channel bottom width, and will require a longer basin to contain the flow. This alternative, in addition to Alternative No. 3 will require more excavation to reduce the water surface elevation to the same safe level as Alternative No. 5.

* This scenario was confirmed from a January 2001 trip to one of many vortex rock weir sites in Northern California. Staff from California Conservation Corps (CCC) in Ukiah, CA explained that a huge boulder had separated from the footer rocks in a vortex weir system. This incident was the only occasion they can recall which involves any maintenance work, where the boulders were later repositioned into place by heavy machinery.

ALTERNATIVE COMPARISON SUMMARY

Criteria	Alternative No. 4(a) Refined Concrete Vortex Weir	Alternative No. 5 Concrete Horizontal Weir	Alternative No. 6 Boulder Weir and Retaining Wall
Fish Passage	Highly reliable passage	Highly reliable passage	Highly reliable passage
Past Problems or Experience	No significant problems expected	No significant problems expected	Boulders for weirs may separate
Environmental Impacts	Eight (8) trees removed	Eleven (11) trees removed	Eleven (11) trees removed
Aesthetics	Less visible than Alternative No. 4 & 5, less hardscape due to one less pool	Less visible than Alternative No. 4, similar looking to existing facility	Highly visible, natural-looking rocks and portion of concrete channel lining
Estimated Costs –Construction –Planning, Admin, Design, R/W, etc. –Total Project Cost	 $915,000 691,500 $1,606,500	 $1,000,000 691,500 $1,691,500	 $2,100,000 691,500 $2,791,500
Annual Maintenance Cost/Maintenance Level	$5,000/ Minor maintenance	$5,000/ Minor maintenance	$5,000/ Minor maintenance
Summary	This alternative is recommended because of low maintenance for sediment removal, high fish passage, minor environmental impacts, most economical than concrete vortex and horizontal weir alternatives due to decreased excavation and concrete amount.	Not selected because of fourth highest project cost after concrete vortex weir alternative and, as in Alternative No. 3, 4, 5 and 6, requires the removal of 11-20 trees due to extra excavation and channel embankment for the five resting pools.	Not selected because of highest project cost and requires more excavation and channel embankment work than all the other alternatives. It is a highly visible structure with a combination of boulders and concrete lining.

REFERENCES

Bates, Ken M., *Fishway Design Guidelines for Pacific Salmon*, Washington Department of Fish and Wildlife, 1997.

Berlogar, Long & Associates, *Geotechnical Investigation Proposed Stevens Creek Flood Control Improvements Central Expressway to San Francisco Bay, Santa Clara County, California*, 1981.

Flosi, G., S. Downie, J. Hopelain, M. Bird, R. Coey, and B. Collins, *California Salmonid Stream Habitat Restoration Manual*, State of California Resources Agency, Department of Fish and Game, Inland Fisheries Division, Third Edition, 1998.

Katopodis, C., *Introduction to Fishway Design*, Freshwater Institute, Central and Arctic Region, Department of Fisheries and Oceans, 1992.

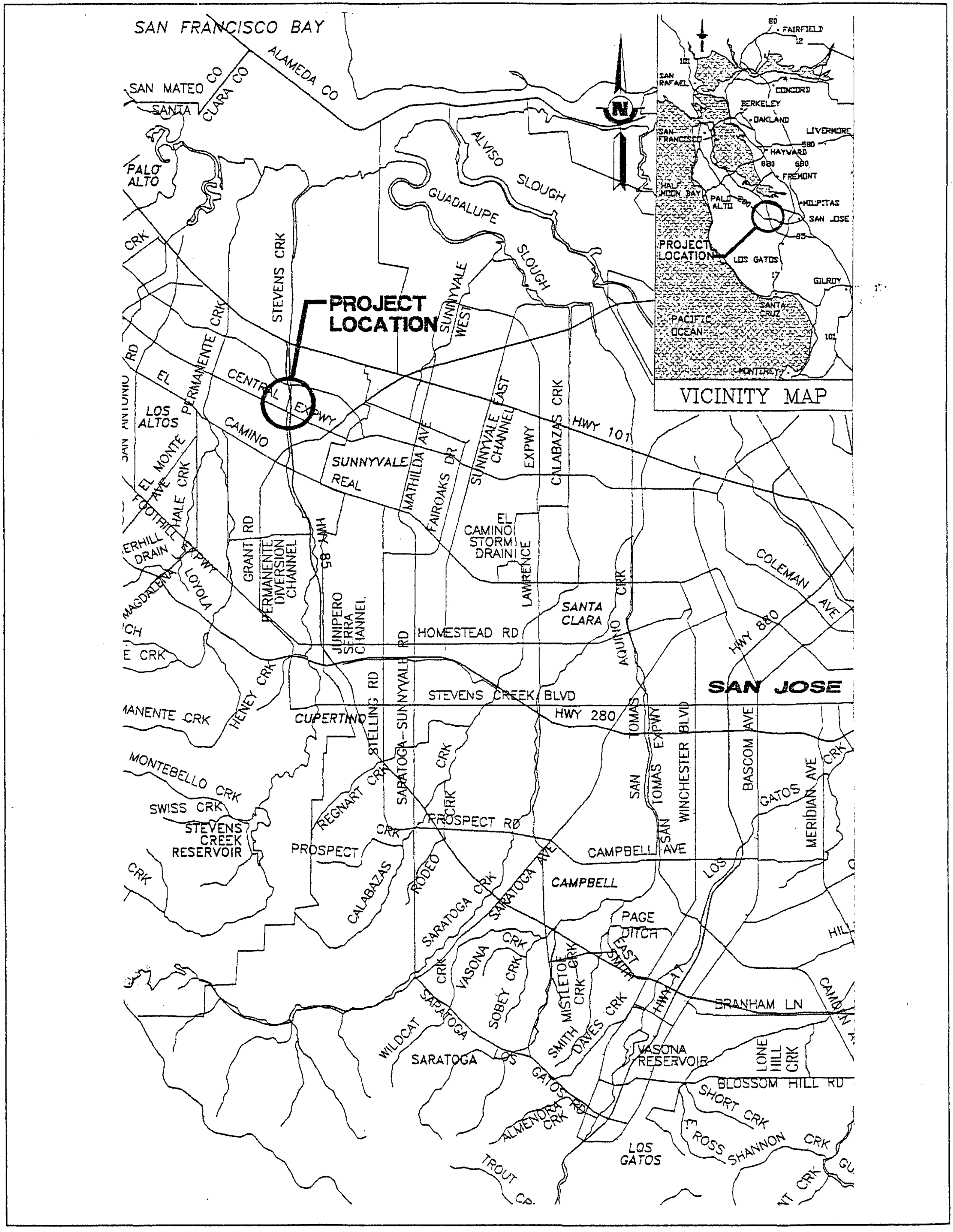
State of California, Department of Transportation (Caltrans), *Standard Specifications*, 1999.

State of California, Department of Transportation (Caltrans), Internet Website, *Highway Design Manual, Chapter 870—Channel and Shore Protection—Erosion Control.*

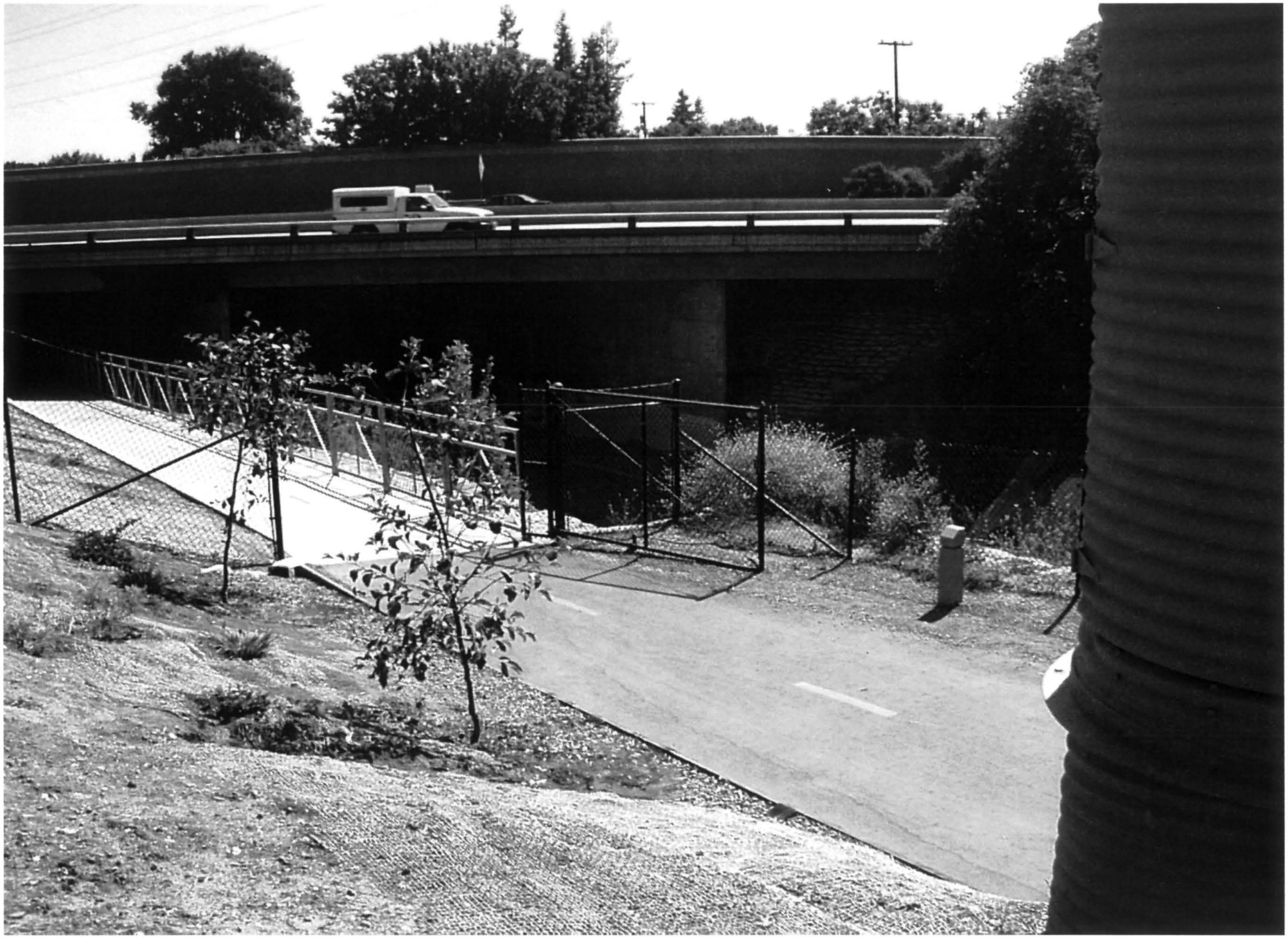
Website: http://www.dot.ca.gov/hq/oppd/hdm/hdmtoc.htm

APPENDIX A

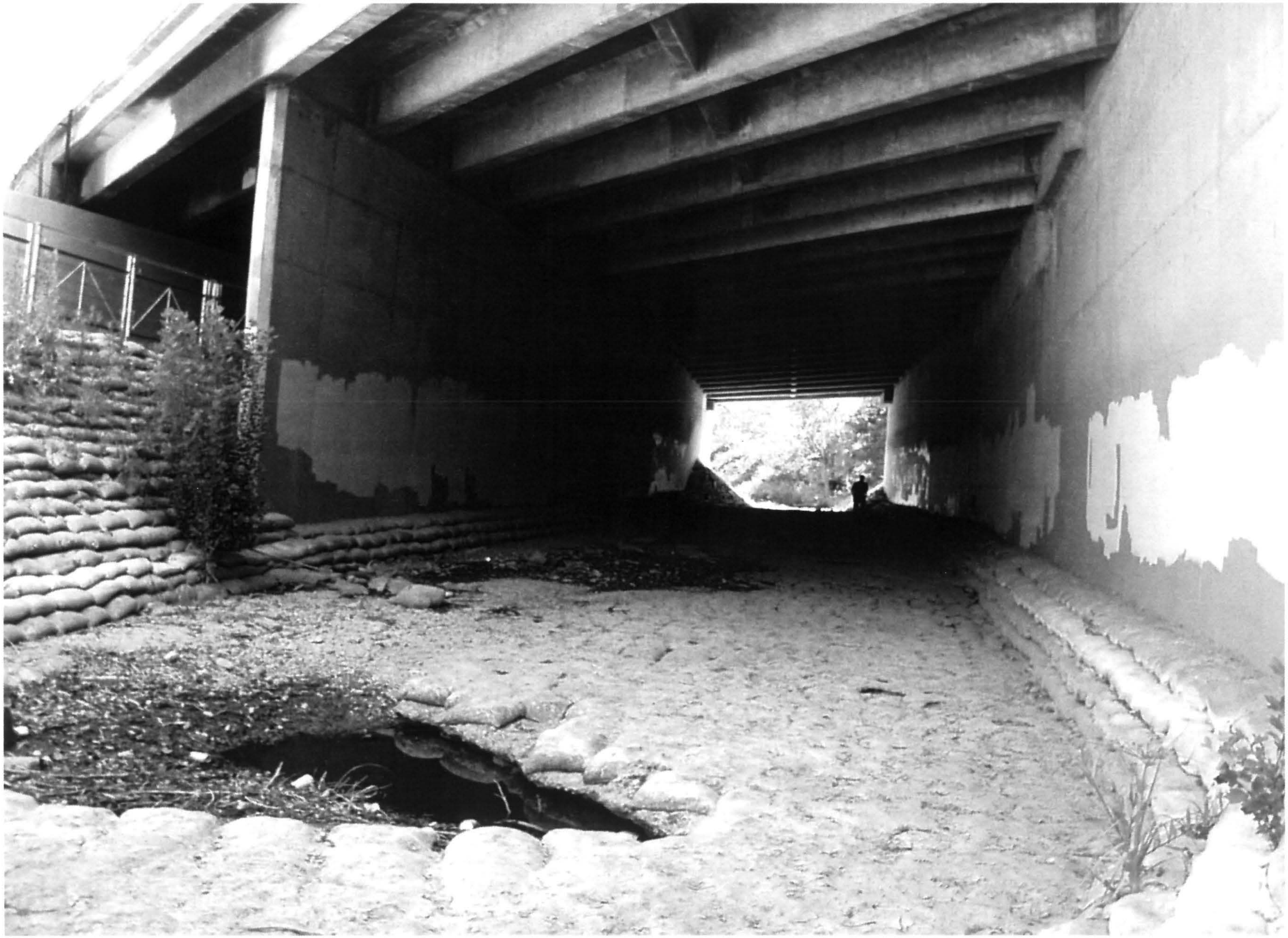
Map and Photos



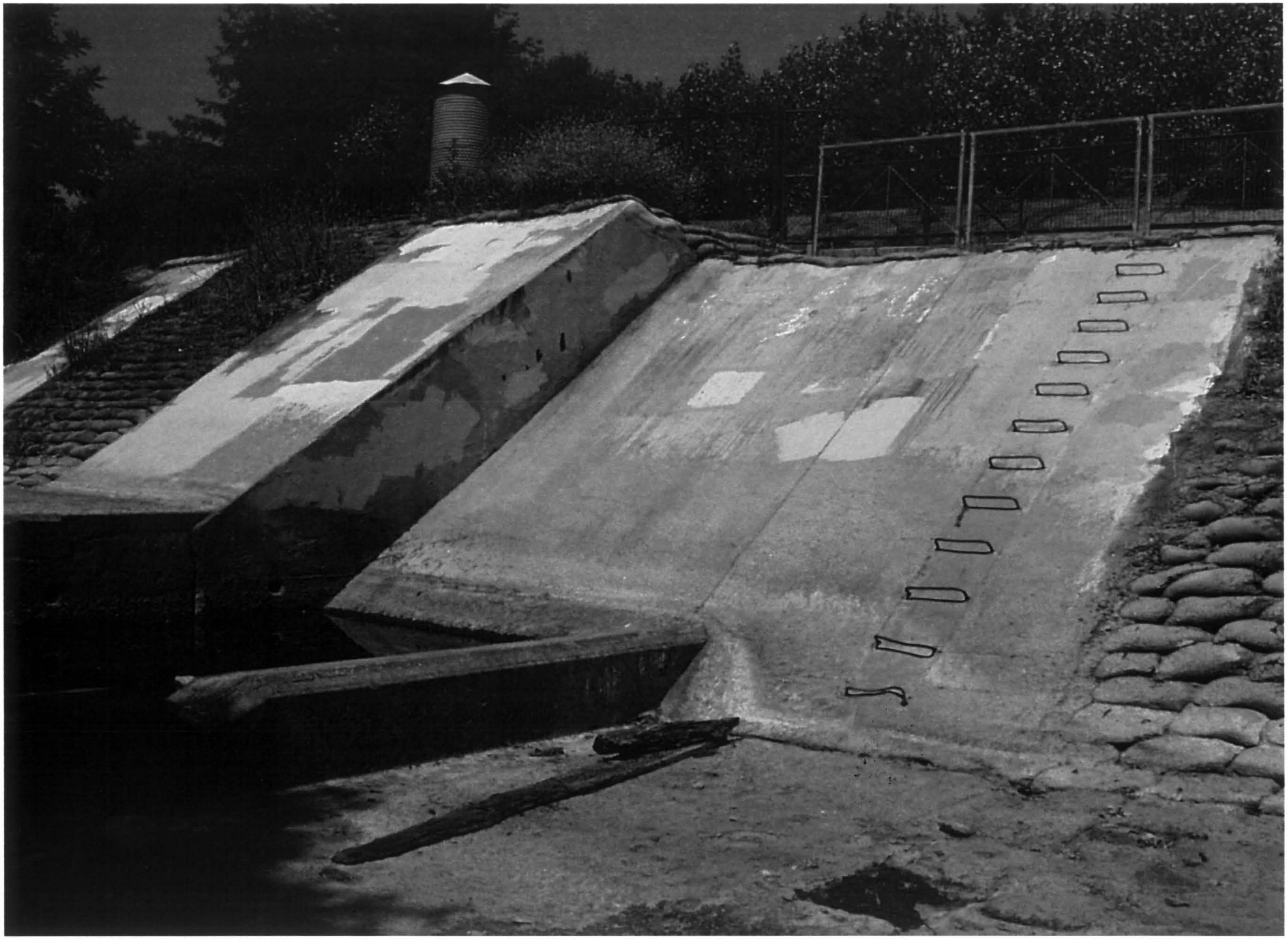
A1 Location Map



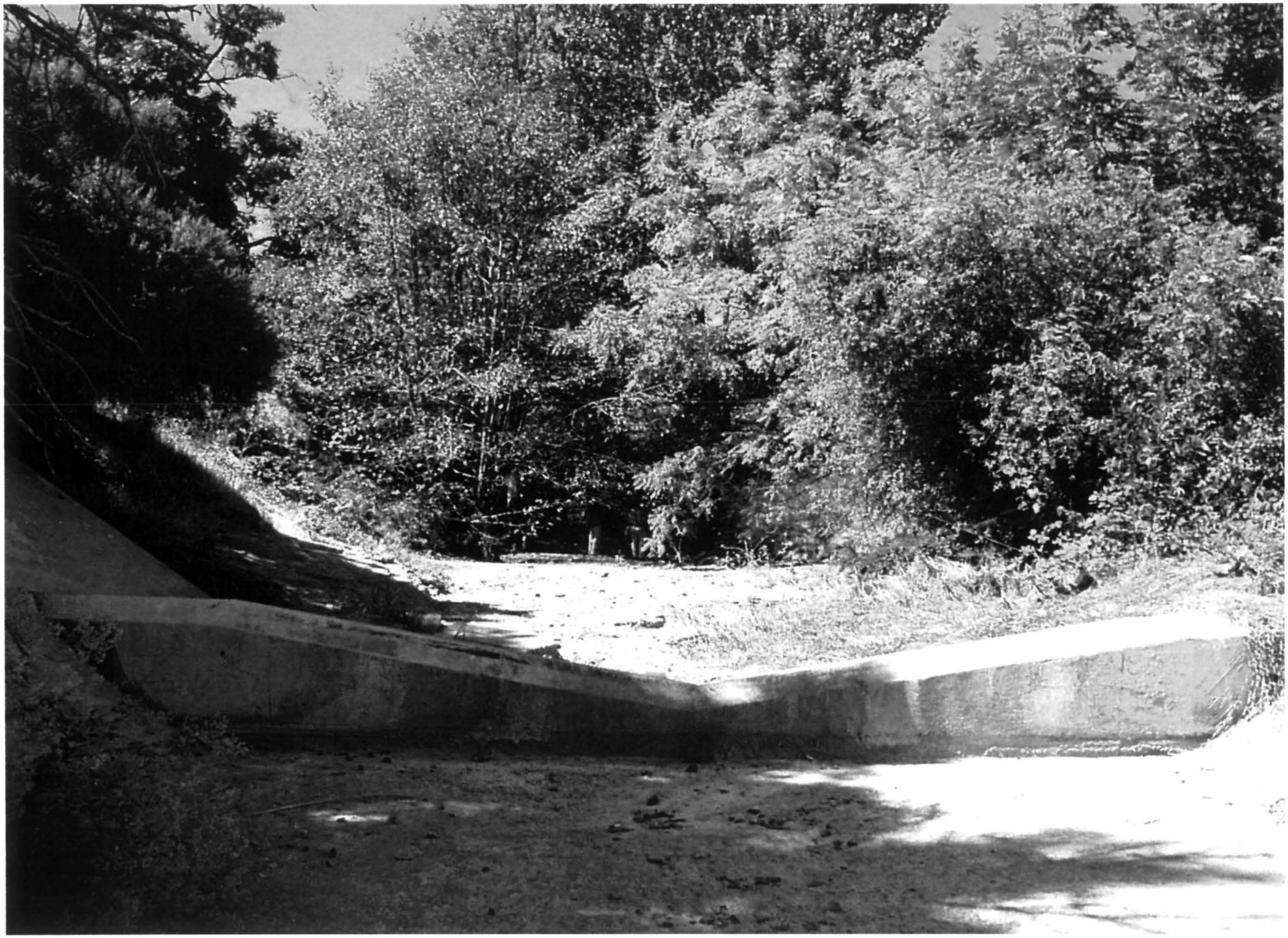
A2 Stream Gage Station 35 Adjacent to Pedestrian Trail



A3 Channel Invert by Highway 85



A4 Existing Drop Structure Facility



A5 Upstream Concrete Weir

APPENDIX B

Preliminary Drawings and Sketches

B1 Preliminary Plans

(NOTE: These plans were sent to CDFG on July 13, 1999, and were reviewed favorably by their hydraulic engineer. The same plans were also sent to the National Marine Fisheries Service on July 28, 1999, and they concurred with CDFG.)

Santa Clara Valley Water District

5750 Almaden Expressway, San Jose 95118, Phone 265-2600

Page 1 of

Charge No. 1029-01

By TJI

Date 5/21/99

Checked by GML Date 8/6/01

Subject STEVENS CREEK FISH LADDER @ GAGE STATION 35 - HYDROLOGICAL & HYDRAULIC CONSIDERATIONS

1) @ 5% SLOPE,

LENGTH OF TYPICAL POOL = 6.8M (SEE SECTION A-A)

AREA OF TYPICAL POOL = $\left(\frac{2.65+7.45}{2}\right)(2) = 10.1\ M^2$

$\therefore$ VOLUME = $(6.8)(10.1\ M^2) = 68.68\ M^3 \Rightarrow 2{,}425.41\ ft^3$

2) @ 1.181' JUMP HEIGHT, THE MAXIMUM AMOUNT OF FLOW WHICH ALLOWS FOR FULL ENERGY DISSIPATION IS $\Rightarrow Q \leq V/_{16H}$

$\therefore Q \leq 2{,}425.41/(16 \cdot 1.181) = 128.34$ CFS

3) LOOKING AT THE FLOW EXCEEDANCE TABLE, FLOWS UP TO 128.34 CFS CAN OCCUR 94.3% OF THE TIME $\Rightarrow$ THIS IS HIGHER THAN THE FISH & GAME REQUIREMENT OF MINIMUM 90% FLOWS.

Values from Flow Statistics Table (see next sheet):

100 cfs —— 6.9% of Migration Season

128.34 cfs —— Percentage "X"

150 cfs —— 4.8% of Migration Season

Through interpolation, solve for "X"

100	6.9
128.34	X
150	4.8

$$\frac{128.34-100}{150-100} = \frac{X-6.9}{4.8-6.9}$$

X = 5.709% of Migration Season where flows exceeds 128.34 cfs

100% - 5.709% = 94.3% of Migration Season where flows up to 128.34 cfs can be hydraulically contained in each pool.

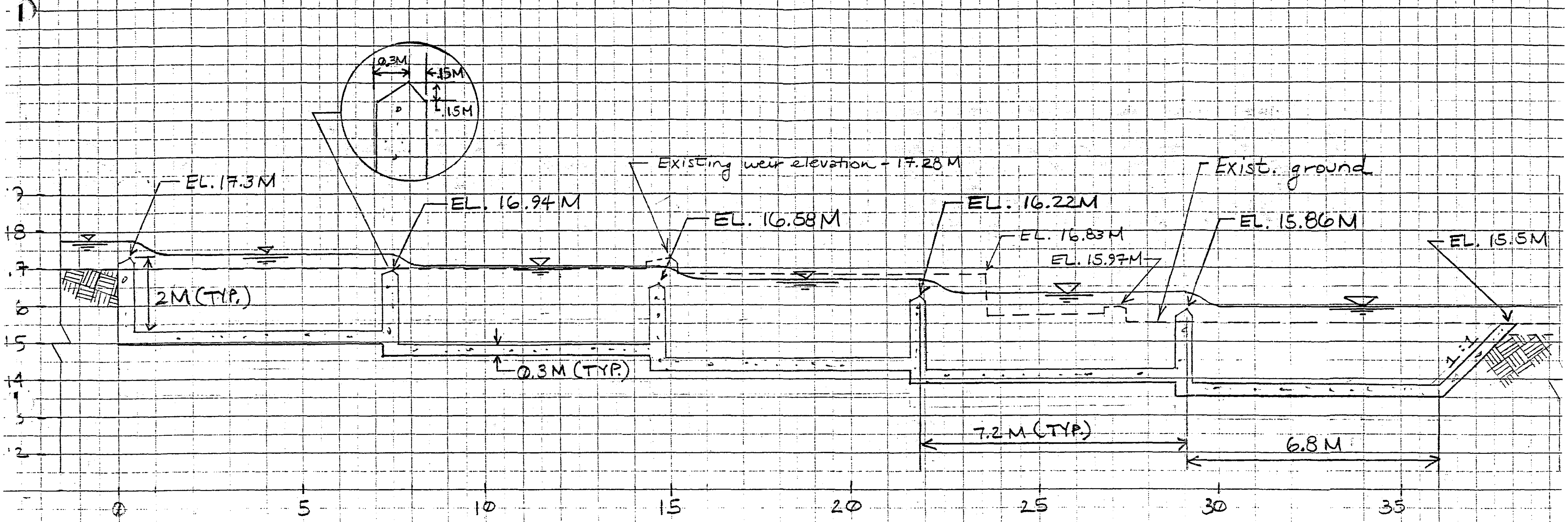
B.T. November 2000

Flow Statistics for Streamflow Gage Station 35 at Stevens Creek*

Water Year	Total Hours of Record (Total Time)	Total Hours of Record (Migration Season**)	Number of Hours In Year When Flow Exceeded "x" CFS																							
			5		10		25		50		100		150		200		250		300		350		400		500	
1950	8760	6192	24.0	0.0	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1951	8760	6192	6600.0	5088.0	1512.0	960.0	552.0	336.0	216.0	168.0	48.0	24.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	24.0
1952	8784	6192	7056.0	4248.0	2808.0	528.0	2280.0	1200.0	1088.0	480.0	600.0	240.0	360.0	144.0	216.0	48.0	168.0	24.0	144.0	0.0	144.0	48.0	96.0	0.0	96.0	96.0
1953	8760	6192	5952.0	5064.0	888.0	672.0	216.0	120.0	96.0	72.0	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1954	8760	6192	3600.0	3600.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1955	8760	6192	6528.0	6312.0	216.0	168.0	48.0	48.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1956	8784	6192	5136.0	3072.0	2064.0	528.0	1536.0	240.0	1296.0	696.0	600.0	384.0	216.0	48.0	168.0	0.0	168.0	24.0	144.0	0.0	144.0	0.0	144.0	72.0	72.0	72.0
1957	8760	6192	2592.0	1920.0	672.0	168.0	504.0	24.0	480.0	360.0	120.0	48.0	72.0	72.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1958	8760	6192	4680.0	1896.0	2784.0	600.0	2184.0	744.0	1440.0	528.0	912.0	336.0	576.0	96.0	480.0	192.0	288.0	0.0	288.0	24.0	264.0	0.0	264.0	0.0	264.0	264.0
1959	8760	6192	3408.0	2832.0	576.0	336.0	240.0	96.0	144.0	48.0	96.0	24.0	72.0	48.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	24.0
1960	8784	6192	1896.0	1512.0	384.0	120.0	264.0	120.0	144.0	96.0	48.0	24.0	24.0	0.0	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1961	8760	6192	1824.0	1080.0	744.0	168.0	576.0	96.0	480.0	264.0	216.0	96.0	120.0	24.0	96.0	24.0	72.0	48.0	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0
1962	8760	6192	4512.0	3912.0	600.0	288.0	312.0	144.0	168.0	48.0	120.0	24.0	96.0	24.0	72.0	24.0	48.0	48.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1963	8760	6192	4704.0	2112.0	2592.0	936.0	1656.0	576.0	1080.0	552.0	528.0	240.0	288.0	96.0	192.0	72.0	120.0	24.0	96.0	24.0	72.0	24.0	48.0	0.0	48.0	48.0
1964	8784	6192	2736.0	2472.0	264.0	120.0	144.0	72.0	72.0	24.0	48.0	24.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	24.0
1965	8760	6192	4560.0	2160.0	2400.0	840.0	1560.0	672.0	888.0	504.0	384.0	96.0	288.0	144.0	144.0	48.0	96.0	24.0	72.0	0.0	72.0	0.0	72.0	24.0	48.0	48.0
1966	8760	6192	3456.0	2904.0	552.0	216.0	336.0	168.0	168.0	96.0	72.0	24.0	48.0	24.0	24.0	0.0	24.0	0.0	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0
1967	8760	6192	6072.0	3192.0	2880.0	960.0	1920.0	528.0	1392.0	624.0	768.0	312.0	456.0	168.0	288.0	72.0	216.0	0.0	216.0	48.0	168.0	48.0	120.0	0.0	120.0	120.0
1968	8784	6192	5832.0	5208.0	624.0	96.0	528.0	144.0	384.0	216.0	168.0	24.0	144.0	48.0	96.0	48.0	48.0	24.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	24.0
1969	8760	6192	4872.0	2520.0	2352.0	456.0	1896.0	240.0	1656.0	576.0	1080.0	312.0	768.0	288.0	480.0	96.0	384.0	144.0	240.0	72.0	168.0	0.0	168.0	24.0	144.0	144.0
1970	8760	6192	2952.0	1824.0	1128.0	288.0	840.0	240.0	600.0	336.0	264.0	120.0	144.0	24.0	120.0	24.0	96.0	48.0	48.0	0.0	48.0	0.0	48.0	24.0	24.0	24.0
1971	8760	6192	7392.0	5736.0	1656.0	744.0	912.0	504.0	408.0	216.0	192.0	24.0	168.0	72.0	96.0	0.0	96.0	0.0	96.0	24.0	72.0	0.0	72.0	24.0	48.0	48.0
1972	8784	6192	4032.0	3504.0	528.0	48.0	480.0	240.0	240.0	96.0	144.0	144.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1973	8760	6192	8328.0	4416.0	3912.0	960.0	2952.0	792.0	2160.0	1080.0	1080.0	264.0	816.0	144.0	672.0	192.0	480.0	48.0	432.0	72.0	360.0	72.0	288.0	72.0	216.0	216.0
1974	8760	6192	6792.0	4080.0	2712.0	792.0	1920.0	768.0	1152.0	480.0	672.0	168.0	504.0	192.0	312.0	96.0	216.0	24.0	192.0	24.0	168.0	72.0	96.0	24.0	72.0	72.0
1975	8760	6192	8376.0	6552.0	1824.0	408.0	1416.0	504.0	912.0	456.0	456.0	96.0	360.0	48.0	312.0	72.0	240.0	120.0	120.0	72.0	48.0	0.0	48.0	48.0	0.0	0.0
1976	8784	6192	5856.0	5352.0	504.0	288.0	216.0	120.0	96.0	72.0	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1977	8760	6192	576.0	216.0	360.0	72.0	288.0	72.0	216.0	72.0	144.0	72.0	72.0	48.0	24.0	0.0	24.0	0.0	24.0	24.0	0.0	0.0	0.0	0.0	0.0	0.0
1978	8760	6192	2688.0	240.0	2448.0	432.0	2016.0	504.0	1512.0	528.0	984.0	48.0	936.0	120.0	816.0	216.0	600.0	240.0	360.0	120.0	240.0	72.0	168.0	48.0	120.0	120.0
1979	8760	6192	3816.0	2376.0	1440.0	360.0	1088.0	384.0	696.0	192.0	504.0	168.0	336.0	96.0	240.0	24.0	216.0	72.0	144.0	48.0	96.0	24.0	72.0	24.0	48.0	48.0
1980	8784	6192	5256.0	2568.0	2688.0	912.0	1776.0	336.0	1440.0	384.0	1056.0	240.0	816.0	144.0	672.0	96.0	576.0	96.0	480.0	72.0	408.0	72.0	336.0	168.0	168.0	168.0
1981	8760	6192	3264.0	2136.0	1128.0	432.0	696.0	216.0	480.0	264.0	216.0	96.0	120.0	24.0	96.0	0.0	96.0	24.0	72.0	0.0	72.0	72.0	0.0	0.0	0.0	0.0
1982	8760	6192	7248.0	3096.0	4152.0	792.0	3360.0	1032.0	2328.0	768.0	1560.0	336.0	1224.0	408.0	816.0	168.0	648.0	120.0	528.0	72.0	456.0	96.0	360.0	192.0	168.0	168.0
1983	8760	6192	8712.0	2808.0	5904.0	1560.0	4344.0	936.0	3408.0	984.0	2424.0	504.0	1920.0	264.0	1656.0	216.0	1440.0	144.0	1296.0	168.0	1128.0	216.0	912.0	408.0	504.0	504.0
1984	8784	6192	5928.0	3096.0	2832.0	912.0	1920.0	696.0	1224.0	480.0	744.0	264.0	480.0	120.0	360.0	96.0	264.0	72.0	192.0	0.0	192.0	144.0	48.0	0.0	48.0	48.0
1987	8760	6192	1704.0	1224.0	480.0	72.0	408.0	192.0	216.0	120.0	96.0	24.0	72.0	0.0	72.0	24.0	48.0	0.0	48.0	24.0	24.0	0.0	24.0	0.0	24.0	24.0
1988	8784	6192	1224.0	744.0	480.0	144.0	336.0	96.0	240.0	96.0	144.0	72.0	72.0	24.0	48.0	24.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	24.0
1989	8760	6192	480.0	144.0	336.0	48.0	288.0	72.0	216.0	96.0	120.0	72.0	48.0	48.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1990	8760	6192	816.0	408.0	408.0	48.0	360.0	120.0	240.0	24.0	216.0	24.0	192.0	72.0	120.0	72.0	48.0	24.0	24.0	0.0	24.0	0.0	24.0	0.0	24.0	24.0
1991	8760	6192	768.0	240.0	528.0	72.0	456.0	120.0	336.0	120.0	216.0	72.0	144.0	48.0	96.0	48.0	48.0	0.0	48.0	24.0	24.0	24.0	0.0	0.0	0.0	0.0
1992	8784	6192	1920.0	696.0	1224.0	600.0	624.0	120.0	504.0	96.0	408.0	168.0	240.0	96.0	144.0	0.0	144.0	24.0	120.0	48.0	72.0	0.0	72.0	24.0	48.0	48.0
Totals:	**359424.0**	**253872.0**	**174168.0**		**61608.0**		**43448.0**		**29816.0**		**17496.0**		**12240.0**		**9024.0**		**7008.0**		**5592.0**		**4584.0**		**3600.0**		**2424.0**	
% of Total Time:	**100.0**	**-**	**48.5**		**17.1**		**12.1**		**8.3**		**4.9**		**3.4**		**2.5**		**1.9**		**1.6**		**1.3**		**1.0**		**0.7**	
% of Migration Season	**-**	**100.0**	**68.6**		**24.3**		**17.1**		**11.7**		**6.9**		**4.8**		**3.6**		**2.8**		**2.2**		**1.8**		**1.4**		**1.0**	

* Streamflow data obtained from Streamflow Station 35, Stevens Creek.

** Migration Season is from September 16 through May 31 of each water year (approximately 8.5 months)



SECTION A-A

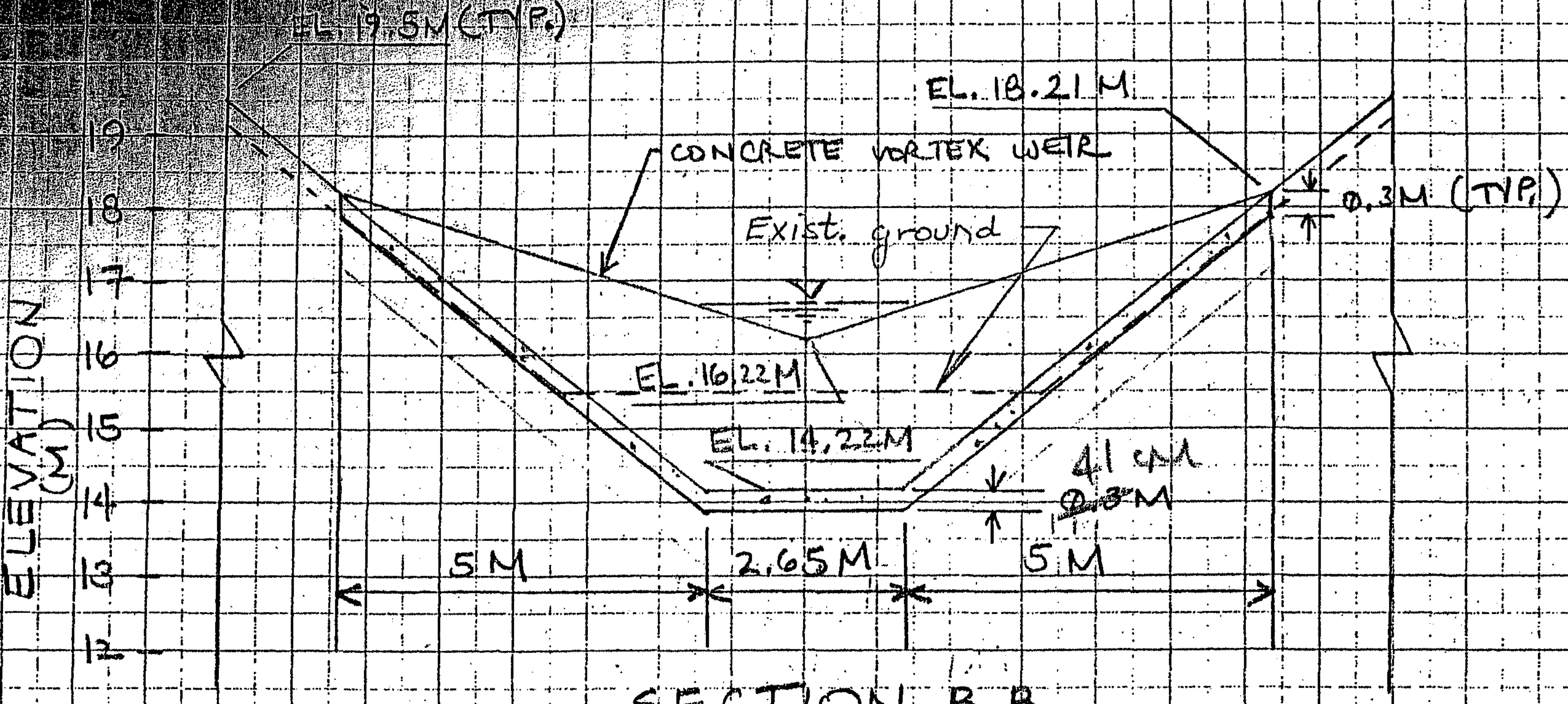
(SCALE: 1 CM=1M)

PRELIMINARY STEVENS CREEK FISH LADDER AT STREAMFLOW STATION NO. 35

Santa Clara Valley Water District

Drawn by: TJI

Date: 5/18/99



SECTION B-B

(SCALE: 1 CM = 1 M)

PRELIMINARY

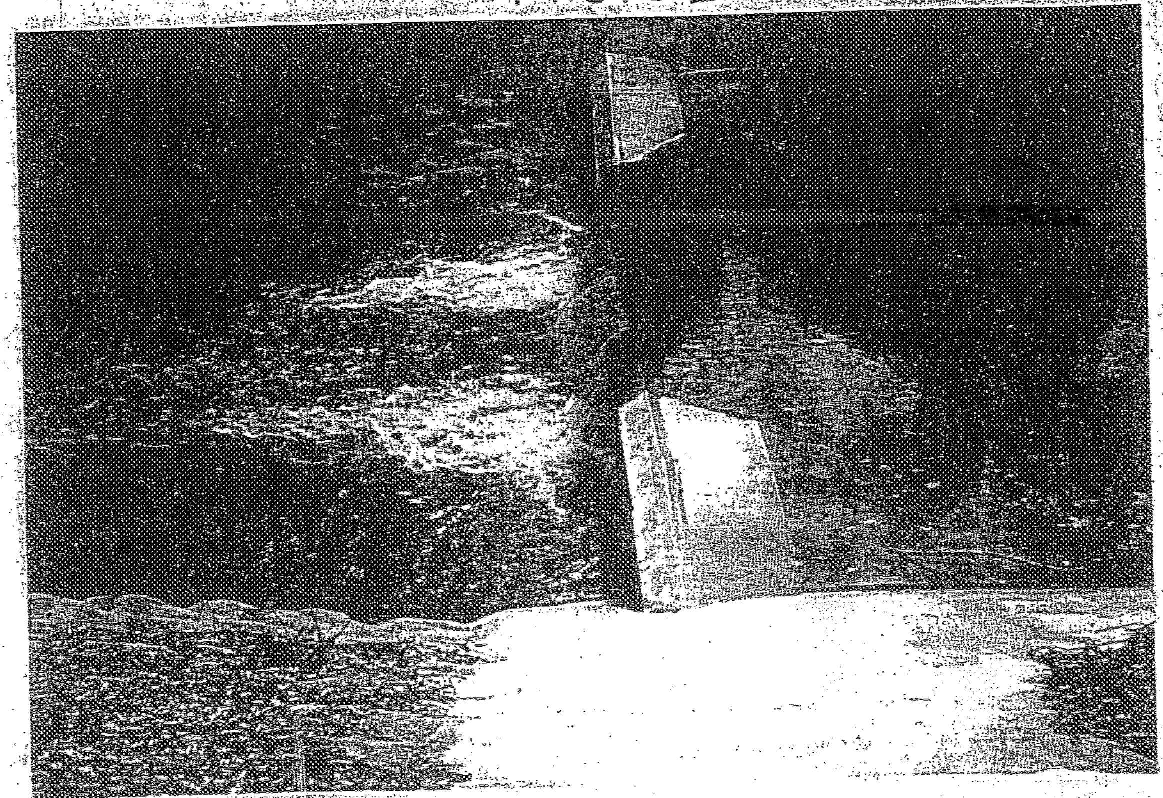
STEVENS CREEK FISH LADDER AT
STREAMFLOW STATION NO. 35
Santa Clara Valley Water District

Drawn by: TJI
Date: 5/18/99

STEVENS CREEK FISH LADDER @ GAGE STATION 35

PHOTO 1

PHOTO 2



STEVENS CREEK FISH LADDER @ GAGE STATION 35

PHOTO 3

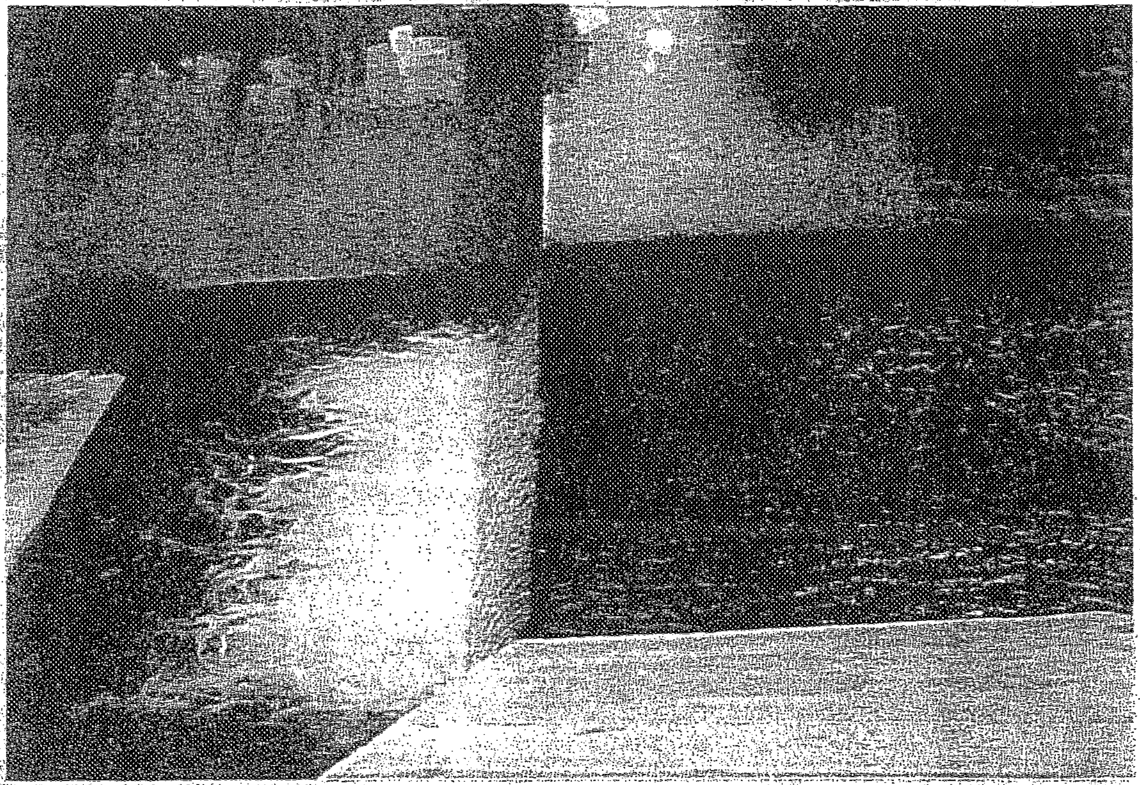
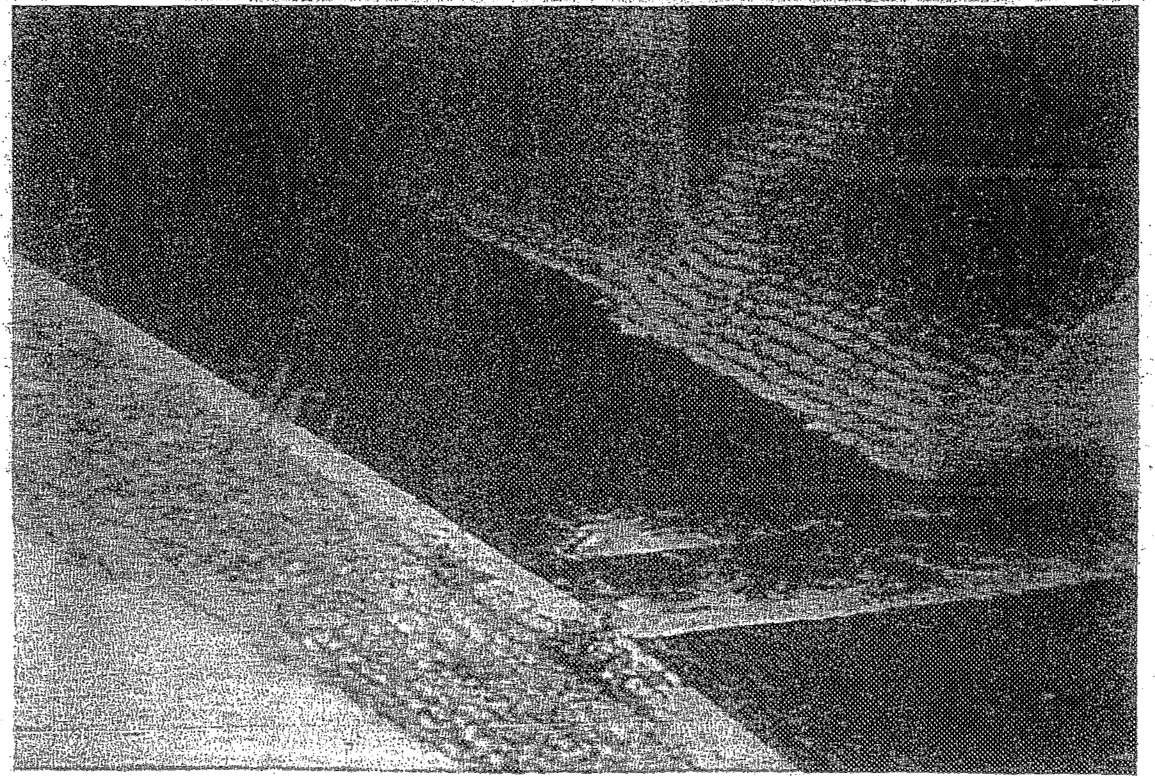


PHOTO 4



STEVENS CREEK FISH LADDER @ GAGE STATION 35

PHOTO 5

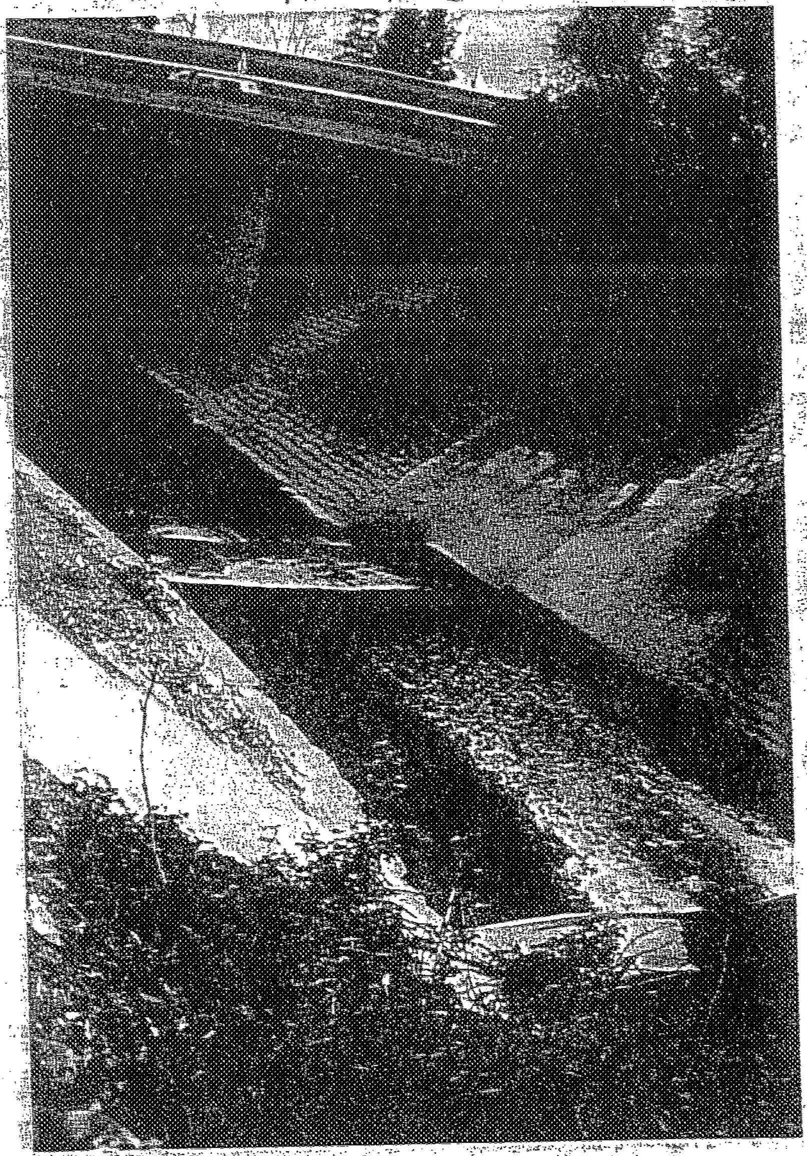
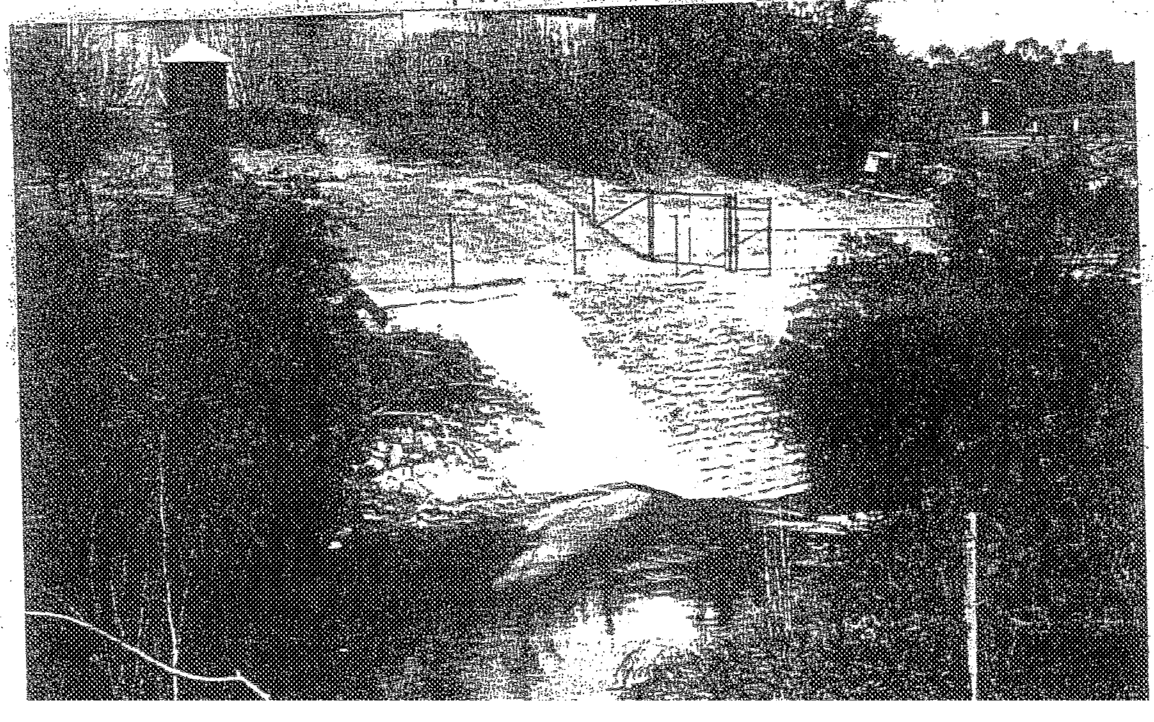


PHOTO 6



STEVENS CREEK FISH LADDER @ GAGE STATION 35

PHOTO 7

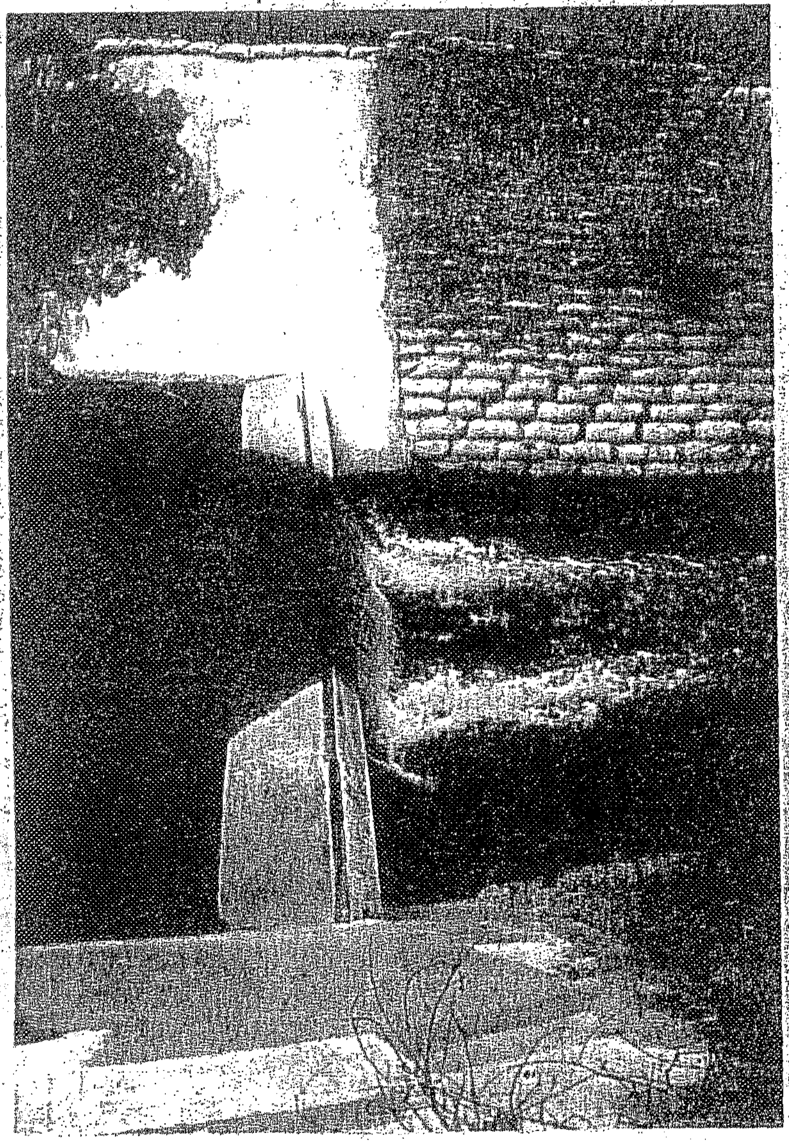
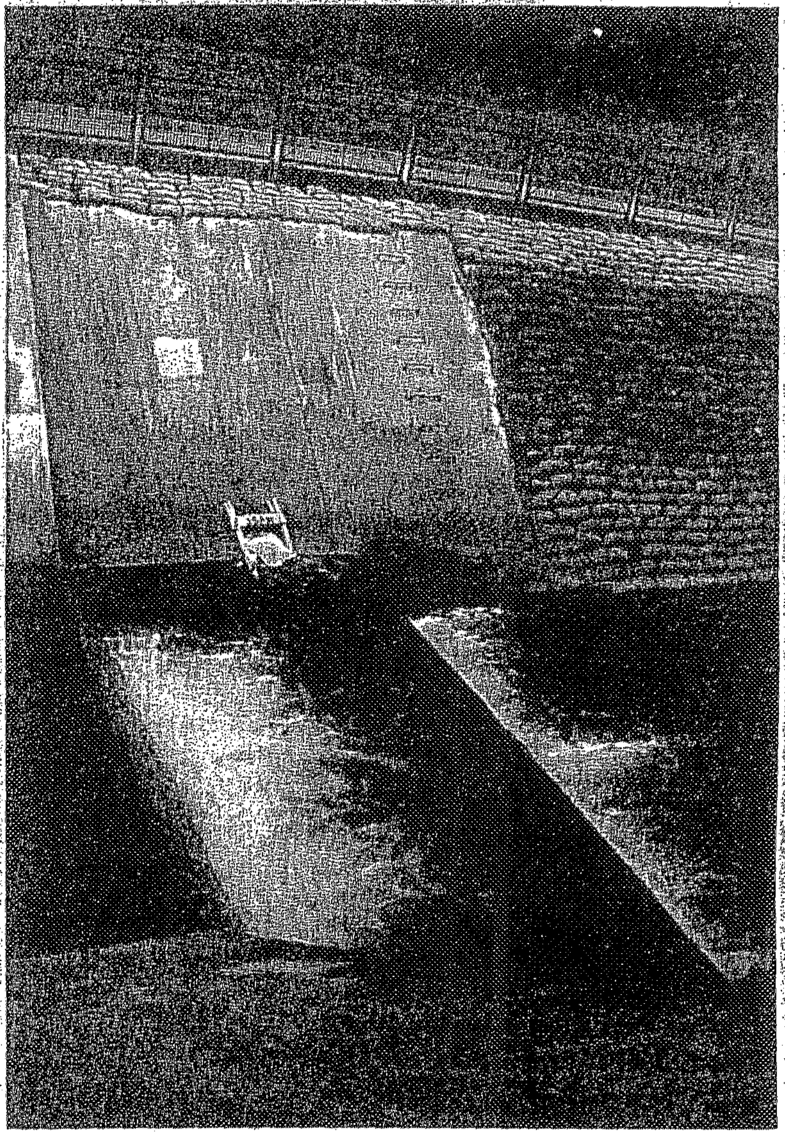


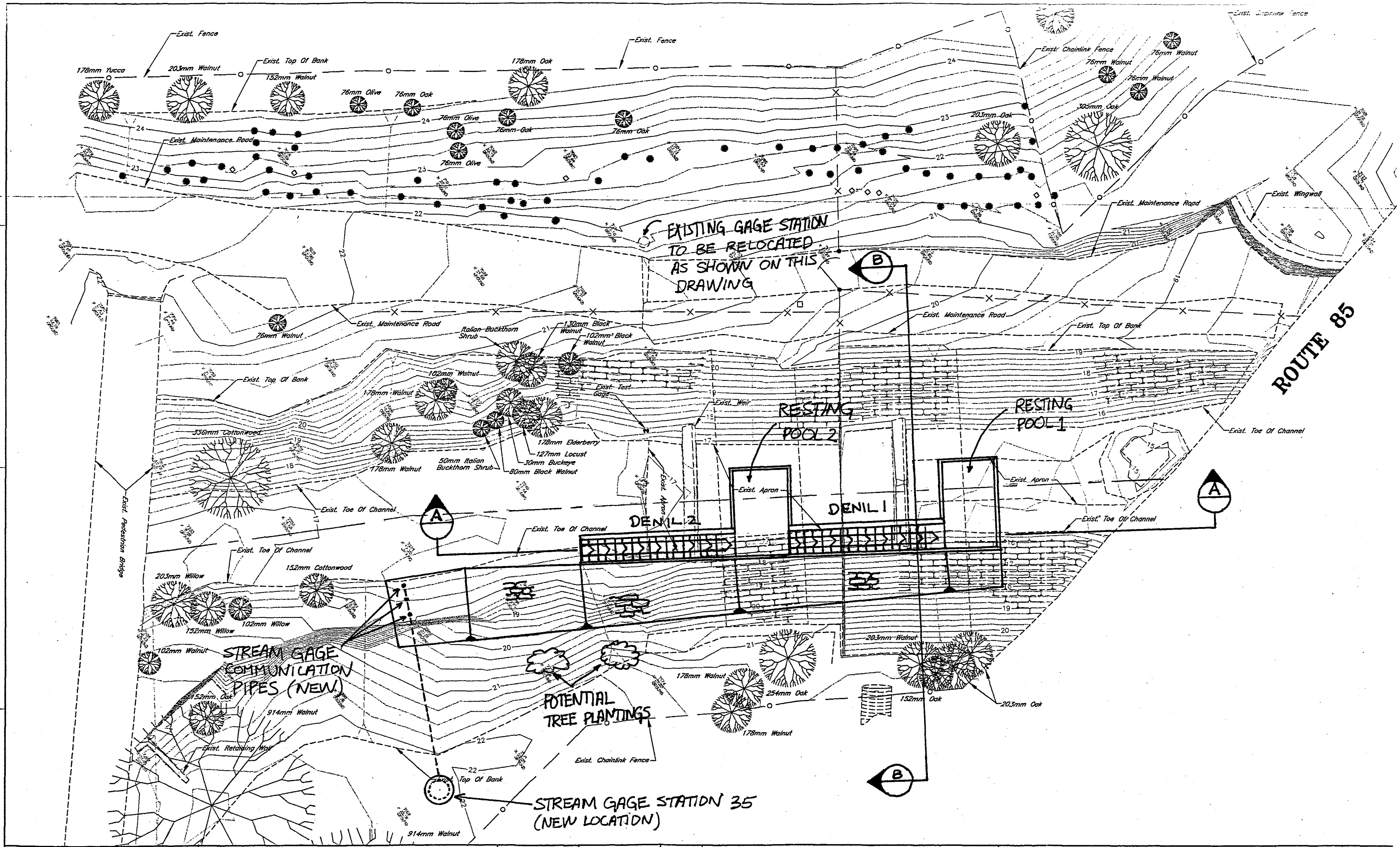
PHOTO 8



APPENDIX B

Preliminary Drawings and Sketches

B2 Denil Fish Ladder Alternative



REV	DESCRIPTION	DATE	APPR	REFERENCE INFORMATION AND NOTES

DATE
DESIGN
DRAWN
CHECKED

Santa Clara Valley Water District

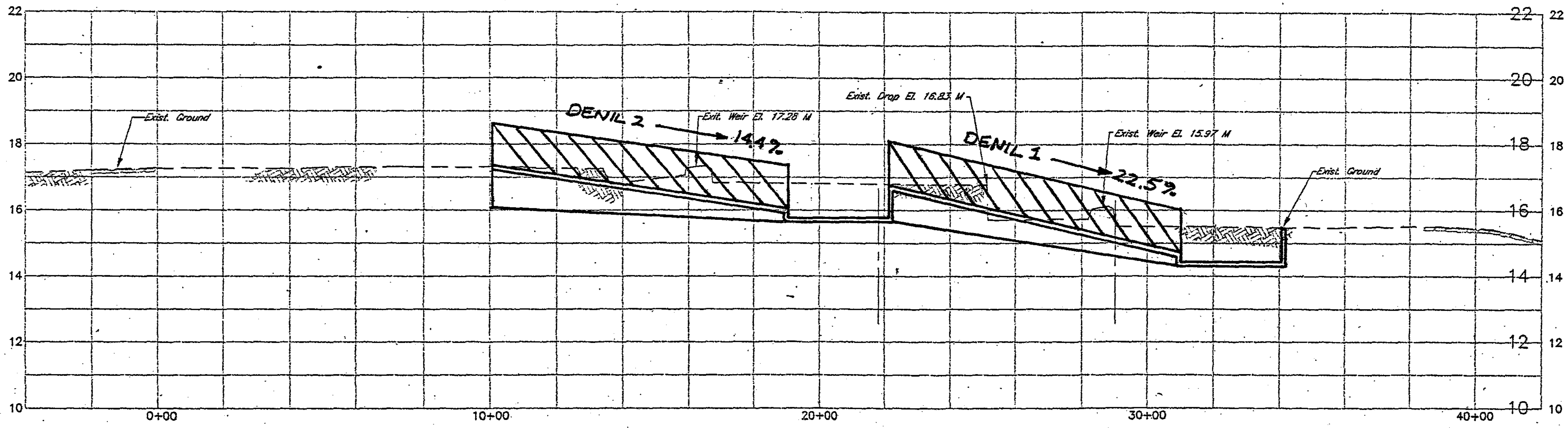
ENGINEERING CERTIFICATION
PROJECT ENGINEER

ENGINEERING APPROVAL
SUPERVISING ENGINEER R.C.E. NO. XXXXX

STREAM GAGE STATION 35
ON STEVENS CREEK
PLANNNG

VERIFY SCALES
0 25
BAR IS 25 MILLIMETERS ON ORIGINAL DRAWING IF NOT ADJUST SCALES ACCORDINGLY

SCALE
1:100
SHEET
OF XX



(A) SECTION
SCALE: NTS

DENIL FISH LADDER ALTERNATIVE
DESIGN: BOBBY TAN
DRAWN: BOBBY TAN
CHECKED: GML
DATE: 10/4/00

Santa Clara Valley Water District

Santa Clara Valley Water District

5750 Almaden Expressway, San Jose 95118, Phone 265-2600

Subject DENIL FISH LADDER ALTERNATIVE

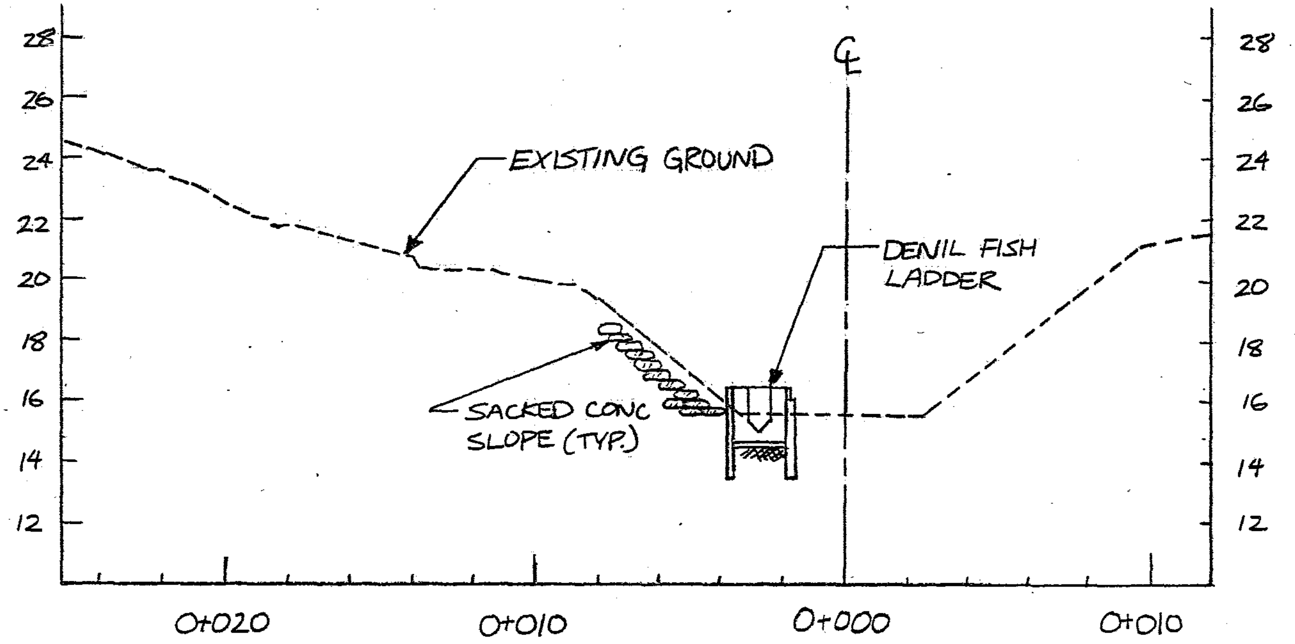
Page 1 of 1

Charge No. 102901

By BOBBY TAN

Date OCT. 10, '00

Checked by GML Date 8/6/01



B SECTION

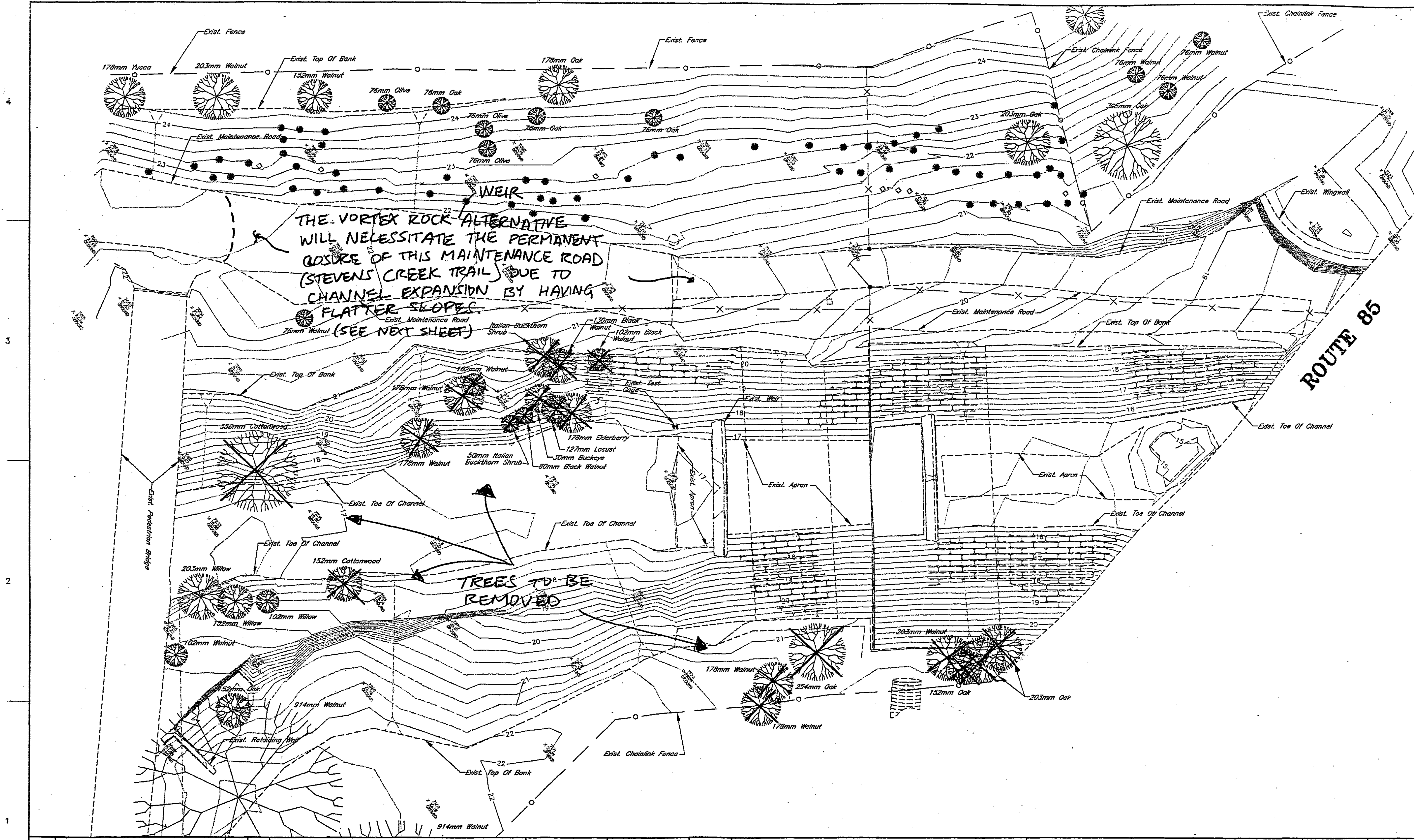
SCALE: NTS

APPENDIX B

Preliminary Drawings and Sketches

B3 Vortex Rock Weir Alternative

(NOTE: In theory, these plans have the same concept as the preliminary plans that were reviewed by CDFG.)



WEIR

THE VORTEX ROCK ALTERNATIVE WILL NECESSITATE THE PERMANENT CLOSURE OF THIS MAINTENANCE ROAD (STEVENS CREEK TRAIL) DUE TO CHANNEL EXPANSION BY HAVING FLATTER SLOPES. (SEE NEXT SHEET)

TREES TO BE REMOVED

REV	DESCRIPTION	DATE	APPR	REFERENCE INFORMATION AND NOTES

DATE 11/11,
DESIGN T
DRAWN 1
CHECKED

Santa Clara Valley Water District

ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO.

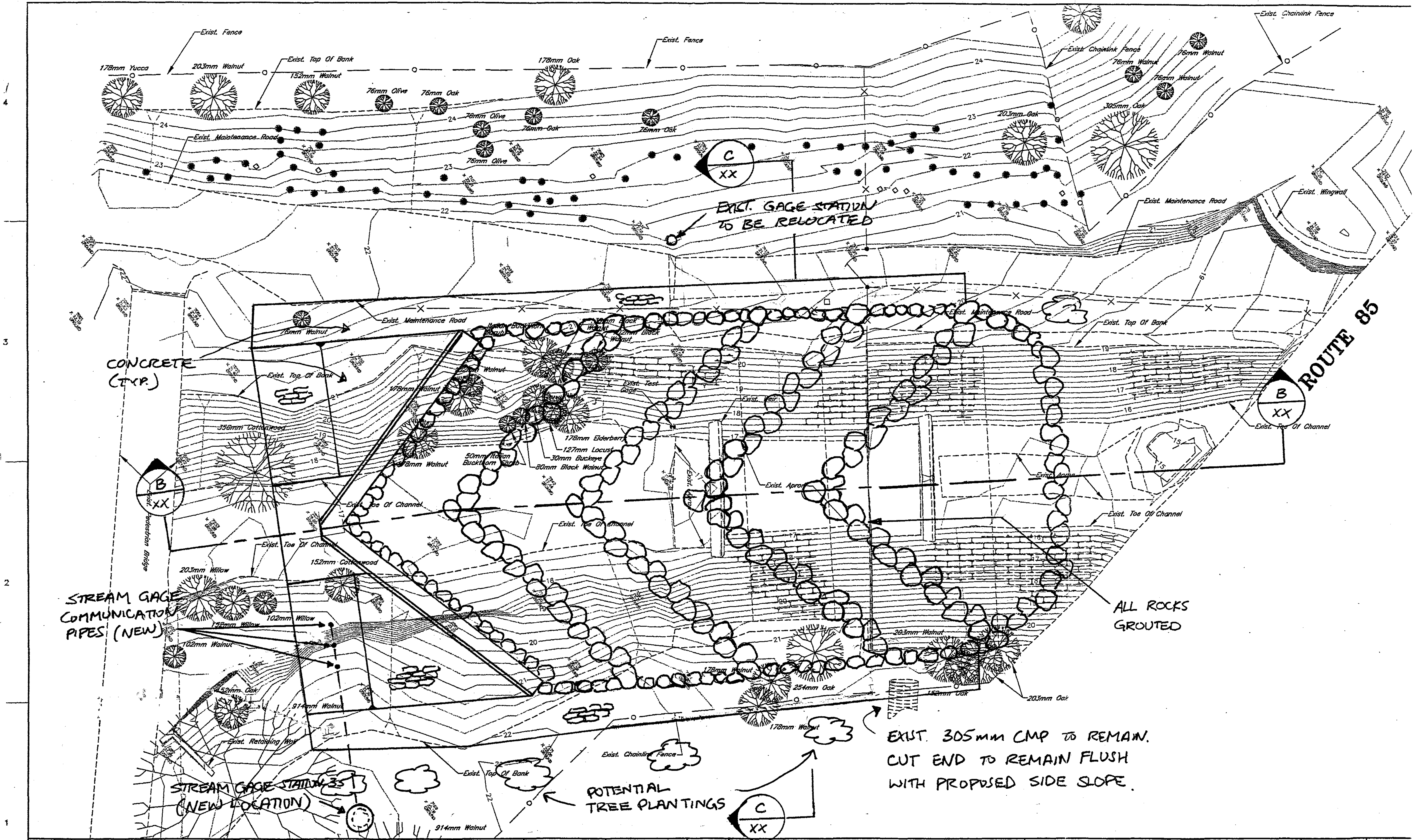
ENGINEERING APPROVAL
SUPERVISING ENGINEER R.C.E. NO. XXXXX

(STREAM GAGE STATION 35
ON STEVENS CREEK

VERIFY SCALES
0 25
BAR IS 25 MILLIMETERS ON ORIGINAL DRAWING IF NOT ADJUST SCALES ACCORDINGLY

SCALE 1:100
SHEET
OF XX

G:\DWGS\SDSKPROJ\1029_01\SHEETS\SHT_005.DWG 9-29-99 11:15:33 AM EST



REV	DESCRIPTION	DATE	APPR	REFERENCE INFORMATION AND NOTES

DATE
DESIGN
DRAWN
CHECKED

Santa Clara Valley Water District

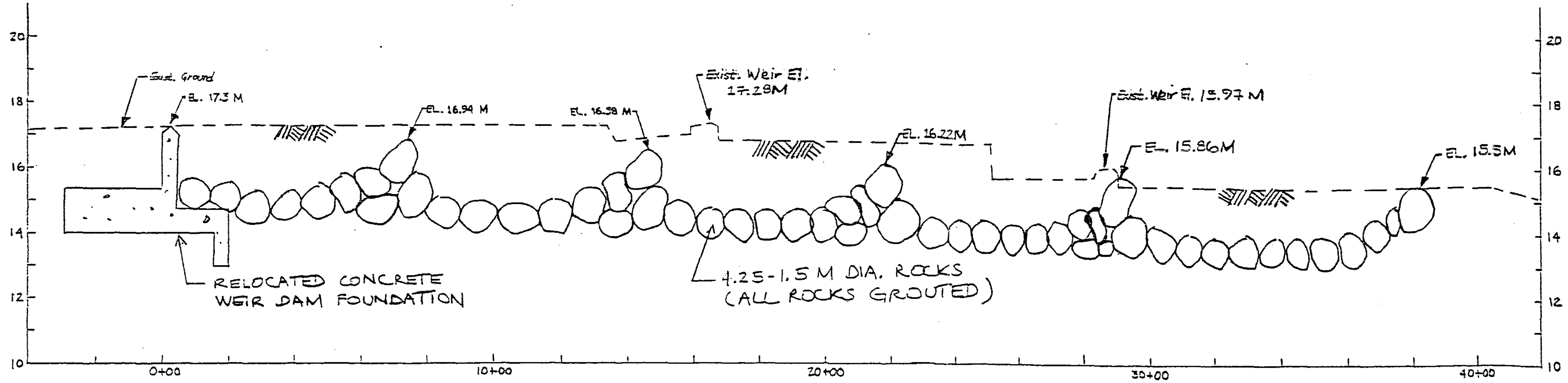
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO.

ENGINEERING APPROVAL
SUPERVISING ENGINEER R.C.E. NO. XXXXX

STREAM GAGE STATION 35
ON STEVENS CREEK

VERIFY SCALES
0 25
BAR IS 25 MILLIMETERS ON ORIGINAL DRAWING IF NOT ADJUST SCALES ACCORDINGLY

SCALE
NTS
SHEET
OF XX



B SECTION
XX SCALE: NTS

PRELIMINARY PLANS
DESIGN BY: TED J. IBARRA
DRAWN BY: TED J. IBARRA
DATE: NOV. 2, 1999

STEVENS CREEK
FISH LADDER AND RELOCATION OF STREAM
GAGE STATION 35 - VORTEX ROCK WEIR
ALTERNATIVE
Santa Clara Valley Water District

Santa Clara Valley Water District

5750 Almaden Expressway, San Jose 95118, Phone 265-2600

STEVENS CREEK FISH

Subject LADDER - ROCK VORTEX
WEIR ALTERNATIVE

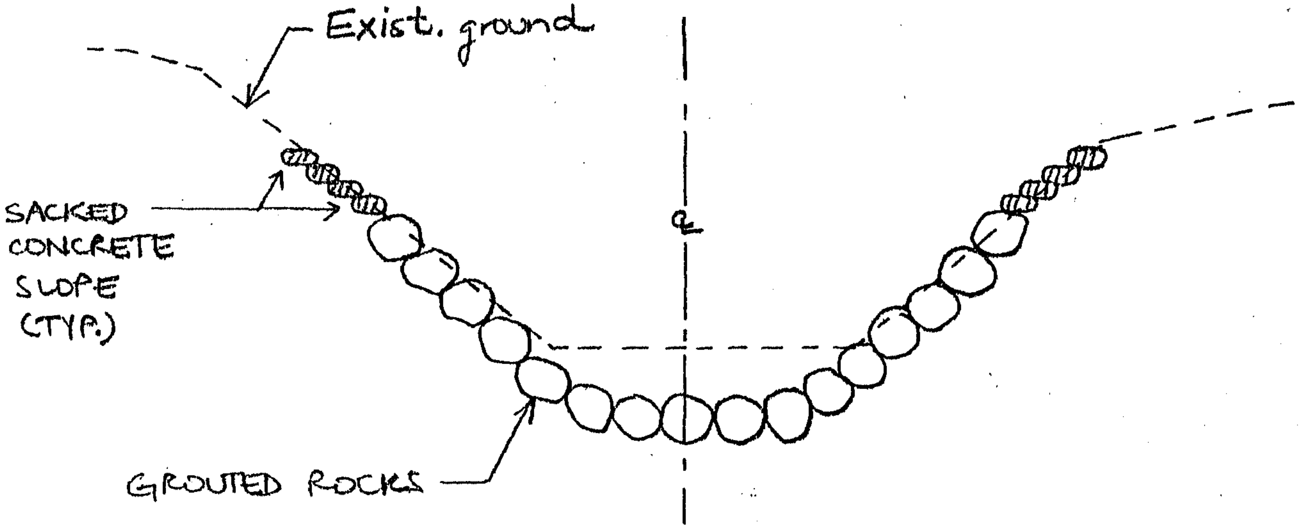
Page 1 of 1

Charge No. 1029-01

By TED J. IBARRA

Date 11/19/99

Checked by GML Date 8/6/01



C/XX SECTION
NTS

FC 867 (10-21-92)

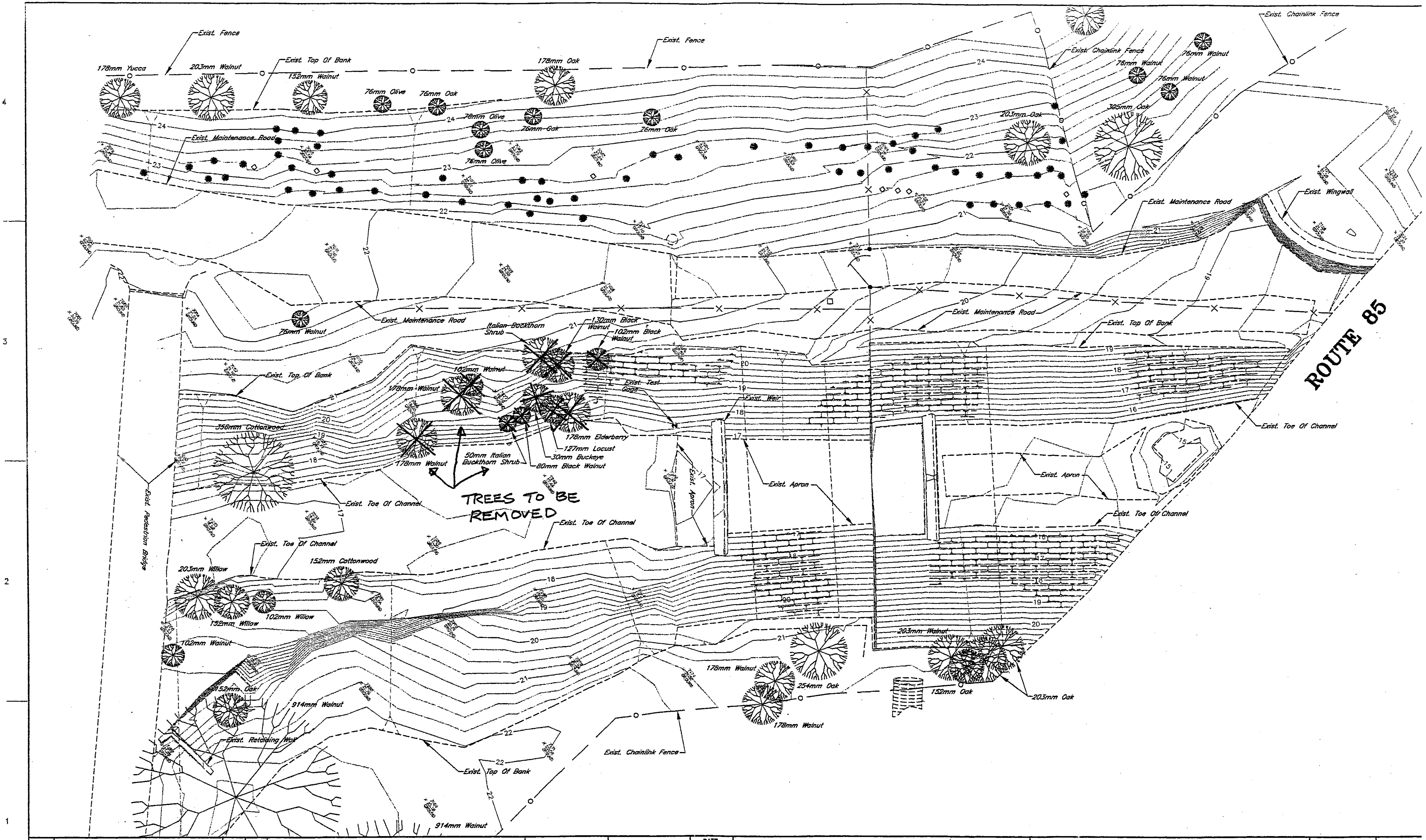
printed on recycled par

APPENDIX B

Preliminary Drawings and Sketches

B4 Concrete Vortex Weir Alternative

(NOTE: These plans reflect further design studies of the preliminary plans that were sent and reviewed by CDFG. Again, the concept is the same and more is added to this alternative.)



TREES TO BE REMOVED

REV	DESCRIPTION	DATE	APPR	REFERENCE INFORMATION AND NOTES

DATE
11/11/00
DESIGN
TI/BT
DRAWN
P.VU/CAM
CHECKED
G. LAU

Santa Clara Valley Water District

ENGINEERING CERTIFICATION

PROJECT ENGINEER R.C.E. NO.

ENGINEERING APPROVAL

SUPERVISING ENGINEER R.C.E. NO. XXXXX

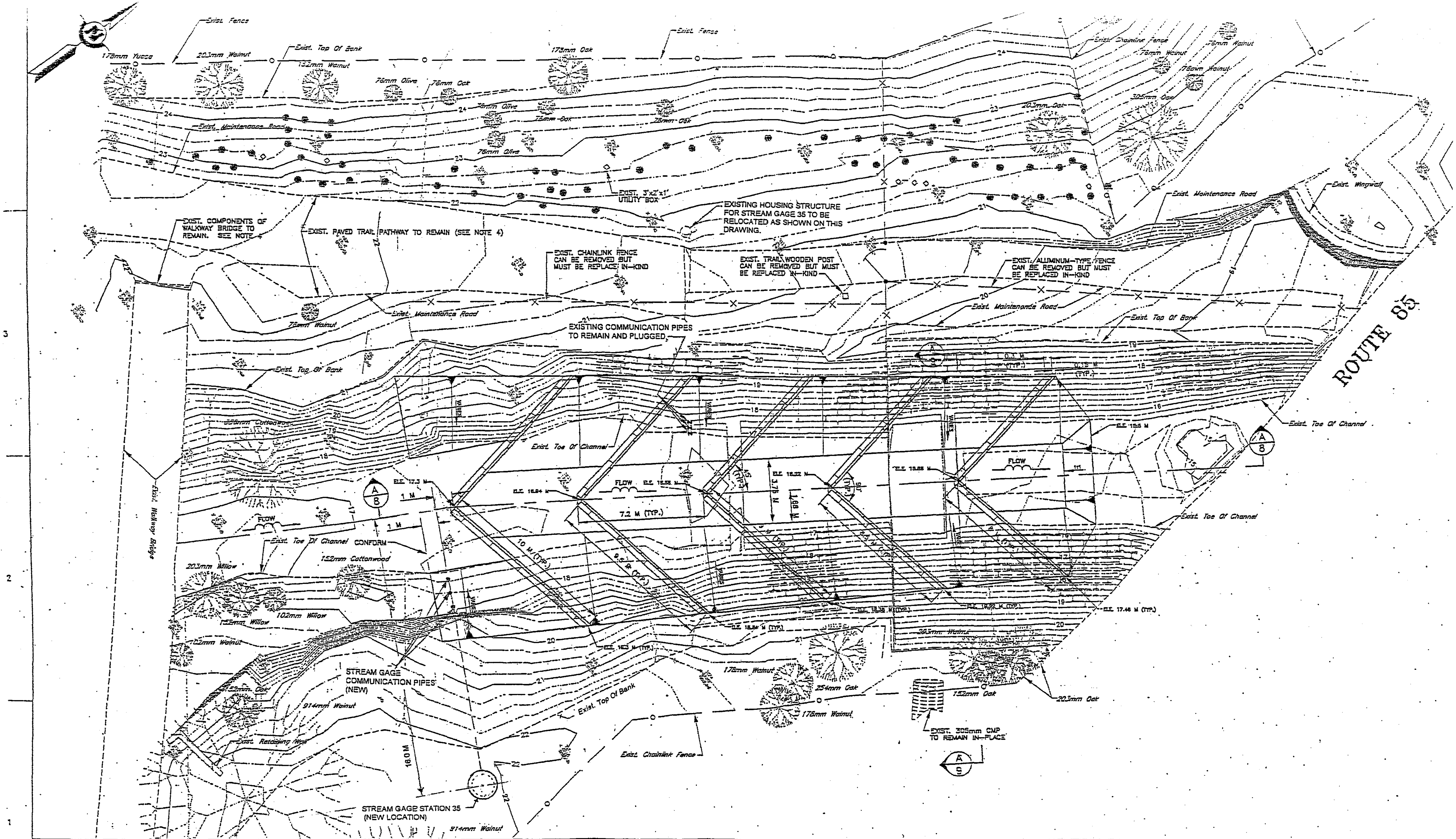
STREAM GAGE STATION 35
ON STEVENS CREEK

VERIFY SCALES
0 25
BAR IS 25 MILLIMETERS ON ORIGINAL DRAWING IF NOT ADJUST SCALES ACCORDINGLY

SCALE
1:100
SHEET

OF XX

G:\DWGS\SDSKPROJ\1029_01\SHEETS\SHT_005.DWG 9-29-99 11:15:33 AM EST



REV	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

1. UNLESS OTHERWISE NOTED ON THESE DRAWINGS, ALL MATERIALS SHALL BE REINFORCED CONCRETE.

DATE

DESIGN

DRAWN

CHECKED

Santa Clara Valley Water District

ENGINEERING CERTIFICATION

PROJECT ENGINEER R.C.E. NO.

ENGINEERING APPROVAL

SUPERVISING ENGINEER R.C.E. NO. 38247

STEVENS CREEK DROP STRUCTURE MODIFICATIONS
UPSTREAM OF HIGHWAY 85
STREAM GAGE STATION 35 RELOCATION

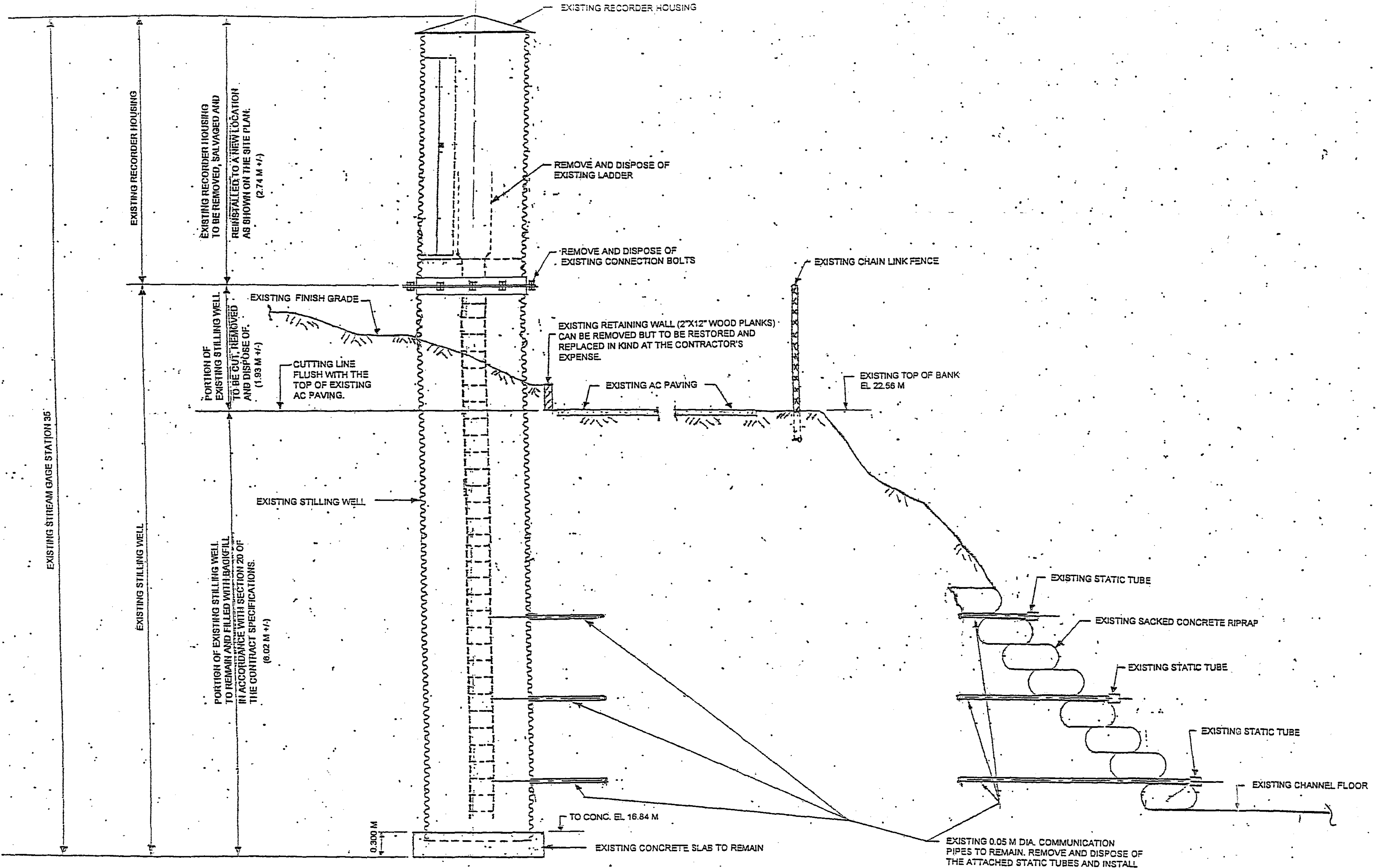
SITE PLAN

VERIFY SCALES
0 25
BAR IS 25 MILLIMETERS ON ORIGINAL DRAWING IF NOT ADJUST SCALES ACCORDINGLY

SCALE 1:100

SHEET

OF


EXISTING RECORDER HOUSING
EXISTING STREAM GAGE STATION 35
EXISTING RECORDER HOUSING
EXISTING STILLING WELL
EXISTING RECORDER HOUSING TO BE REMOVED, SALVAGED AND REINSTALLED TO A NEW LOCATION AS SHOWN ON THE SITE PLAN. (2.74 M +/-)
PORTION OF EXISTING STILLING WELL TO BE CUT, REMOVED AND DISPOSE OF. (1.93 M +/-)
PORTION OF EXISTING STILLING WELL TO REMAIN AND FILLED WITH BACKFILL IN ACCORDANCE WITH SECTION 20 OF THE CONTRACT SPECIFICATIONS. (6.02 M +/-)
REMOVE AND DISPOSE OF EXISTING LADDER
REMOVE AND DISPOSE OF EXISTING CONNECTION BOLTS
EXISTING FINISH GRADE
CUTTING LINE FLUSH WITH THE TOP OF EXISTING AC PAVING.
EXISTING RETAINING WALL (2"X12" WOOD PLANKS) CAN BE REMOVED BUT TO BE RESTORED AND REPLACED IN KIND AT THE CONTRACTOR'S EXPENSE.
EXISTING AC PAVING
EXISTING CHAIN LINK FENCE
EXISTING TOP OF BANK EL 22.56 M
EXISTING STILLING WELL
EXISTING STATIC TUBE
EXISTING SACKED CONCRETE RIPRAP
EXISTING STATIC TUBE
EXISTING STATIC TUBE
EXISTING CHANNEL FLOOR
0.300 M
TO CONC. EL 16.84 M
EXISTING CONCRETE SLAB TO REMAIN
EXISTING 0.05 M DIA. COMMUNICATION PIPES TO REMAIN. REMOVE AND DISPOSE OF THE ATTACHED STATIC TUBES AND INSTALL NEW PLUGS TO THE REMAINING PIPES.

DETAIL (1) EXISTING GAGE STATION 35

NOT TO SCALE

REV	DESCRIPTION	DATE	APPR	REFERENCE INFORMATION AND NOTES

DATE

DESIGN

DRAWN

CHECKED

Santa Clara Valley Water District

ENGINEERING CERTIFICATION

PROJECT ENGINEER R.C.E. NO.

ENGINEERING APPROVAL

SUPERVISING ENGINEER R.C.E. NO.

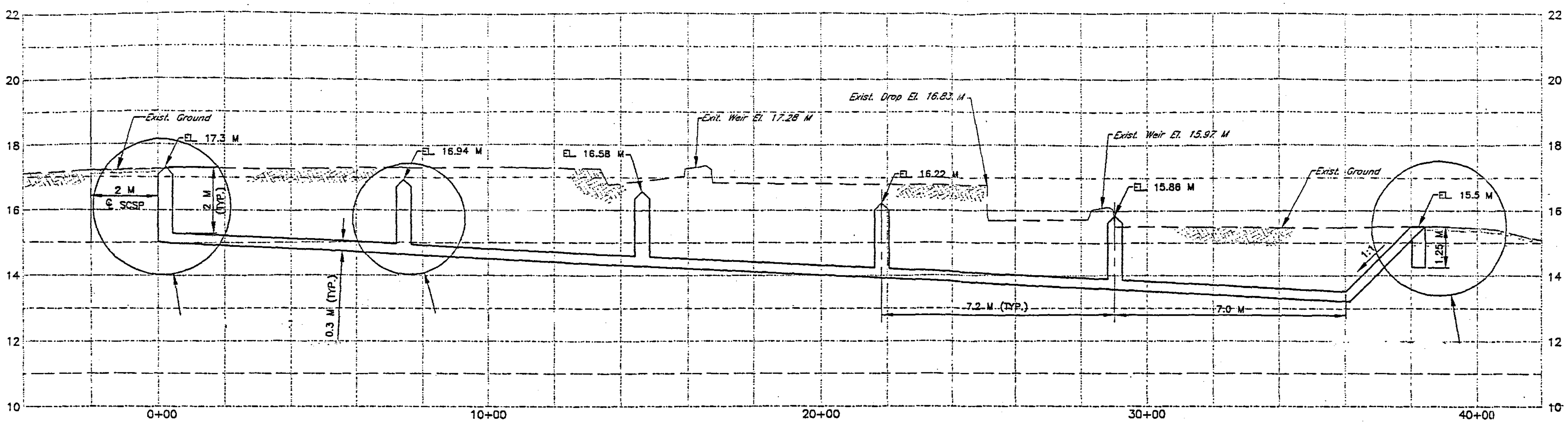
STEVENS CREEK DROP STRUCTURE MODIFICATIONS
UPSTREAM OF HIGHWAY 85
STREAM GAGE STATION 35 RELOCATION

RELOCATION SCHEME

VERIFY SCALES

BAR IS 25 MILLIMETERS ON ORIGINAL DRAWING IF NOT ADJUST SCALES ACCORDINGLY

A B C D E F G H



A / 8 SECTION

SCALE: 1:75

REV	DESCRIPTION	DATE	APPR	REFERENCE INFORMATION AND NOTES

DATE

DESIGN.

DRAWN

CHECKED

Santa Clara Valley Water District

ENGINEERING CERTIFICATION

PROJECT ENGINEER

ENGINEERING APPROVAL

SUPERVISING ENGINEER

VERIFY SCALES

0 25

BAR IS 25 MILLIMETERS ON ORIGINAL DRAWING IF NOT ADJUST SCALES ACCORDINGLY

SCALE AS SHOWN

SHEET

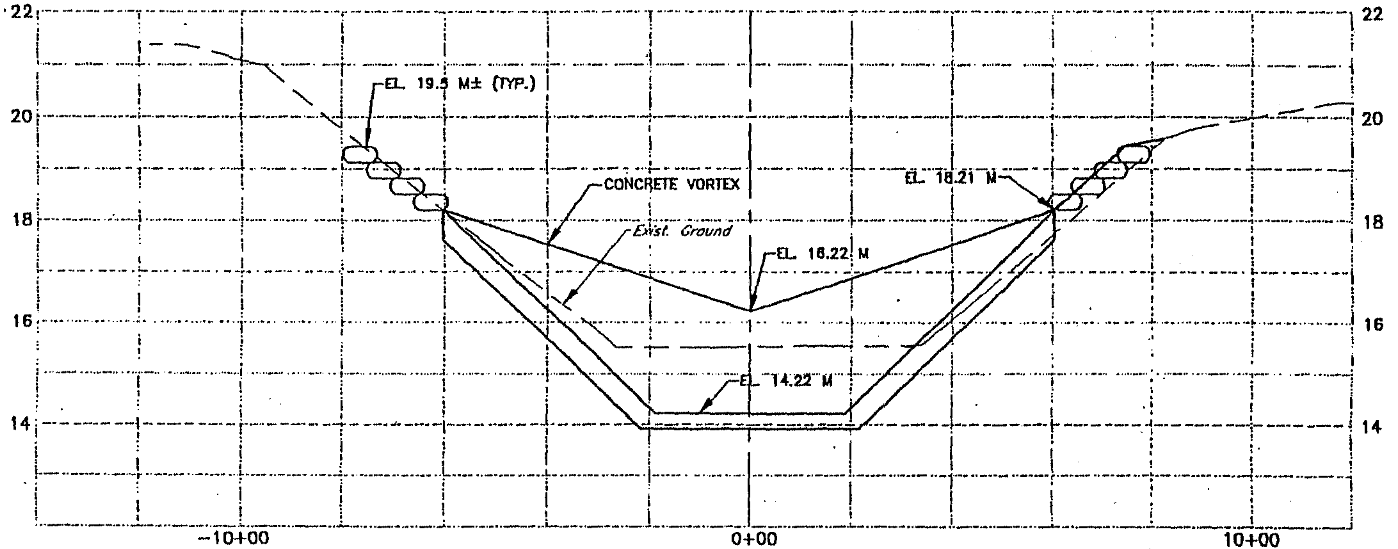
OF XX

G:\DWGS\SDSKPROJ\1029_01\SHEETS\SHT_008.DWG 9-29-99 11:09:08 AM EST

Santa Clara Valley Water District
5750 Almaden Expressway, San Jose 95118, Phone 265-2600

Subject STEVENS CREEK FISH LADDER - CONCRETE VORTEX WEIR ALTERNATIVE

Page 1 of 1
Charge No. 1029-01
By TED J. IBARRA
Date 11/19/99
Checked by GML Date 8/6/01



A/9 SECTION
SCALE: 1:75

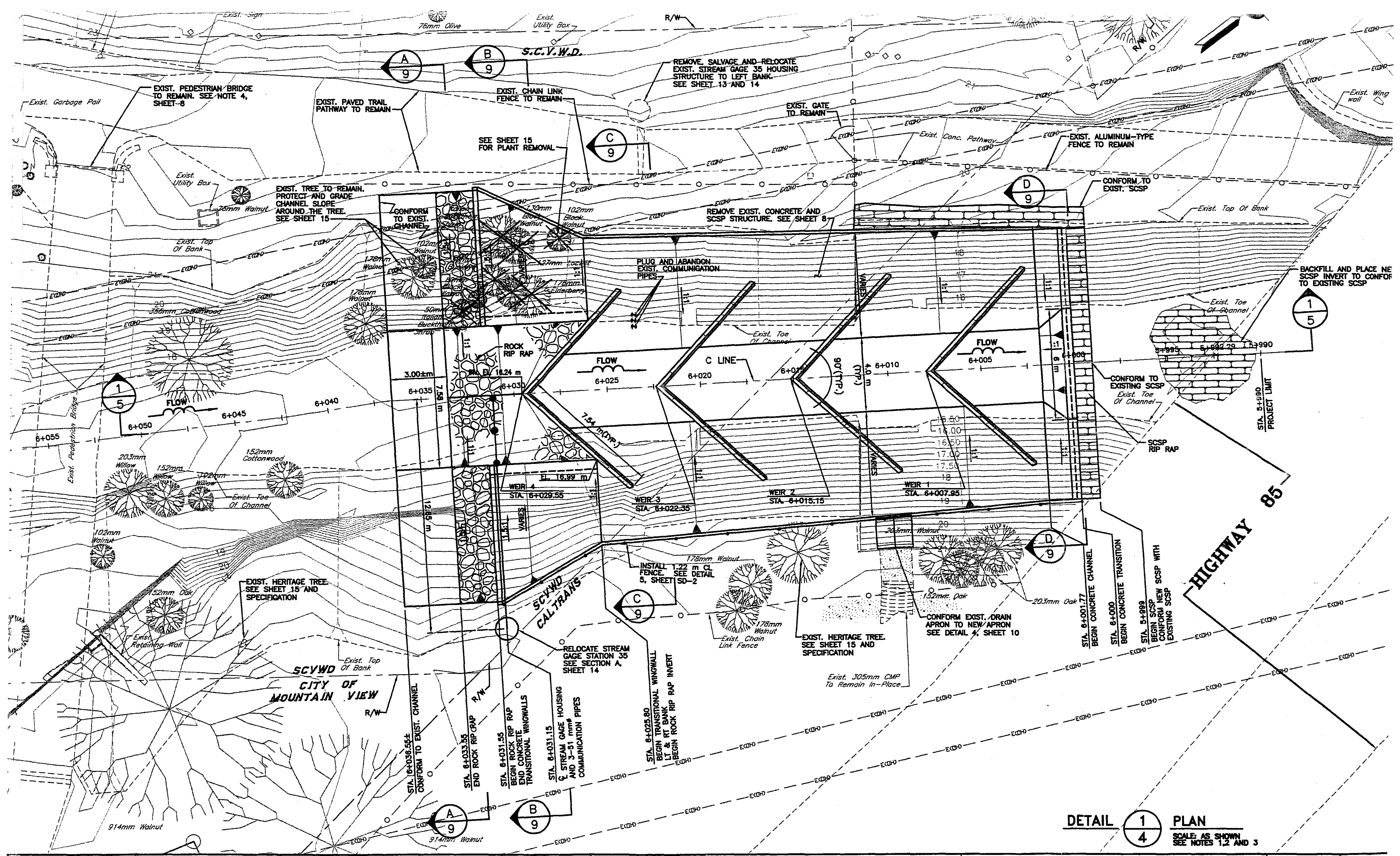
printed on recycled paper

APPENDIX B

Preliminary Drawings and Sketches

B4(a) Refined Concrete Vortex Weir Alternative

(NOTE: These plans reflect further design studies of the preliminary plans that were sent and reviewed by CDFG. Additionally, it has been refined from the original concrete vortex weir alternative in decreased fish jump height and its channel configuration. Again, the concept is still the same and more is added to this alternative from the plans sent to CDFG.)


S.C.V.W.D.
EXIST. PEDESTRIAN BRIDGE TO REMAIN. SEE NOTE 4, SHEET 8
Exist. Garbage Pail
EXIST. PAVED TRAIL PATHWAY TO REMAIN
EXIST. CHAIN LINK FENCE TO REMAIN
REMOVE, SALVAGE AND RELOCATE EXIST. STREAM GAGE 35 HOUSING STRUCTURE TO LEFT BANK. SEE SHEET 13 AND 14
EXIST. GATE TO REMAIN
Exist. Conc. Pathway
EXIST. ALUMINUM-TYPE FENCE TO REMAIN
SEE SHEET 15 FOR PLANT REMOVAL
Exist. Utility Box
Exist. Sign
76mm Olive
R/W
Exist. Wing wall
EXIST. TREE TO REMAIN. PROTECT AND GRADE CHANNEL SLOPE AROUND THE TREE. SEE SHEET 15
CONFORM TO EXIST. CHANNEL
REMOVE EXIST. CONCRETE AND SCSP STRUCTURE. SEE SHEET 8
CONFORM TO EXIST. SCSP
Exist. Top Of Bank
PLUG AND ABANDON EXIST. COMMUNICATION PIPES
BACKFILL AND PLACE NEW SCSP INVERT TO CONFORM TO EXISTING SCSP
Exist. Toe Of Channel
ROCK RIP RAP
INV. EL. 18.24 m
3.00±m
7.58 m
12.65 m
7.54 m (TYP.)
4.0 m (TYP.)
90° (TYP.)
FLOW
C LINE
6+055
6+050
6+045
6+040
6+035
6+030
6+025
6+020
6+015
6+010
6+005
6+000
5+995
5+992.29
5+990
EL. 16.99 m
WEIR 4 STA. 6+029.55
WEIR 3 STA. 6+022.35
WEIR 2 STA. 6+015.15
WEIR 1 STA. 6+007.95
VARIES
1:1
CONFORM TO EXISTING SCSP
SCSP RIP RAP
STA. 5+980 PROJECT LIMIT
HIGHWAY 85
152mm Cottonwood
203mm Willow
152mm Willow
102mm Willow
102mm Walnut
152mm Oak
178mm Walnut
203mm Walnut
203mm Oak
914mm Walnut
EXIST. HERITAGE TREE. SEE SHEET 15 AND SPECIFICATION
INSTALL 1.22 m CL FENCE. SEE DETAIL 5, SHEET SD-2
CONFORM EXIST. DRAIN APRON TO NEW APRON SEE DETAIL 4, SHEET 10
Exist. Chain Link Fence
Exist. 305mm CMP To Remain In-Place
Exist. Retaining Wall
Exist. Top Of Bank
Exist. Pedestrian Bridge
RELOCATE STREAM GAGE STATION 35 SEE SECTION A, SHEET 14
SCVWD CALTRANS
SCVWD CITY OF MOUNTAIN VIEW
STA. 6+036.55± CONFORM TO EXIST. CHANNEL
STA. 6+033.55 END ROCK RIP RAP
STA. 6+031.55 BEGIN ROCK RIP RAP END CONCRETE TRANSITIONAL WINGWALLS
STA. 6+031.15 ℄ STREAM GAGE HOUSING AND 3-51 mmø COMMUNICATION PIPES
STA. 6+025.80 BEGIN TRANSITIONAL WINGWALL LT & RT BANK BEGIN ROCK RIP RAP INVERT
STA. 6+001.77 BEGIN CONCRETE CHANNEL
STA. 6+000 BEGIN CONCRETE TRANSITION
STA. 5+999 BEGIN SCSP CONFORM NEW SCSP WITH EXISTING SCSP
A 9
B 9
C 9
D 9
1 5
E(OH)

DETAIL 1/4 PLAN

SCALE: AS SHOWN
SEE NOTES 1,2 AND 3

	DATE	APPR	REFERENCE INFORMATION AND NOTES
			1. SEE SPECIFICATIONS FOR CALTRANS ENCROACHMENT PERMIT. THE CONTRACTOR SHALL BE RESPONSIBLE FOR COMPLYING

GORDON M. LAU

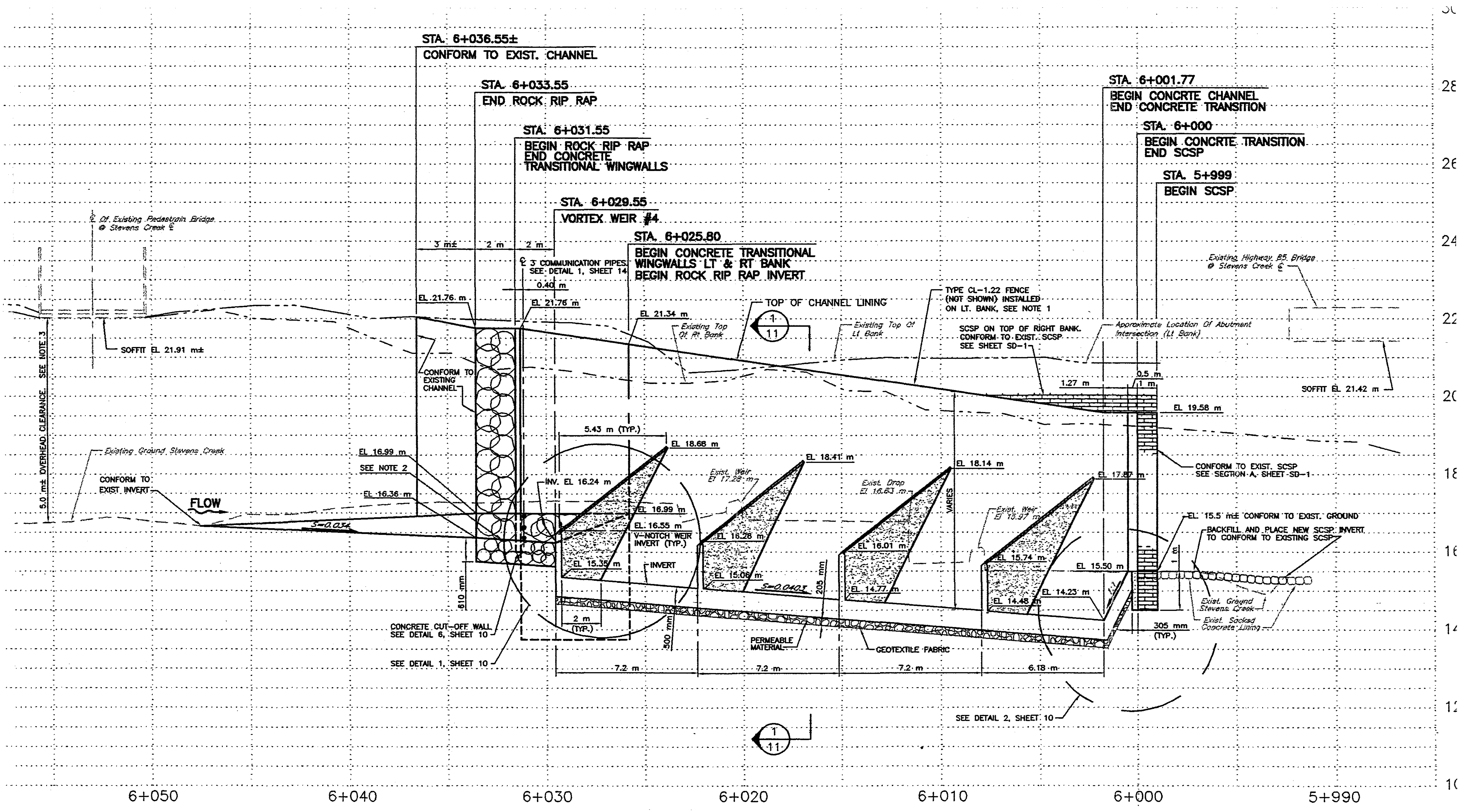
DATE
APRIL 2002
DESIGN
B. TAN

Santa Clara Valley Water District

STEVENS CREEK
DROP STRUCTURE MODIFICATION

VERIFY SCALES
0 25

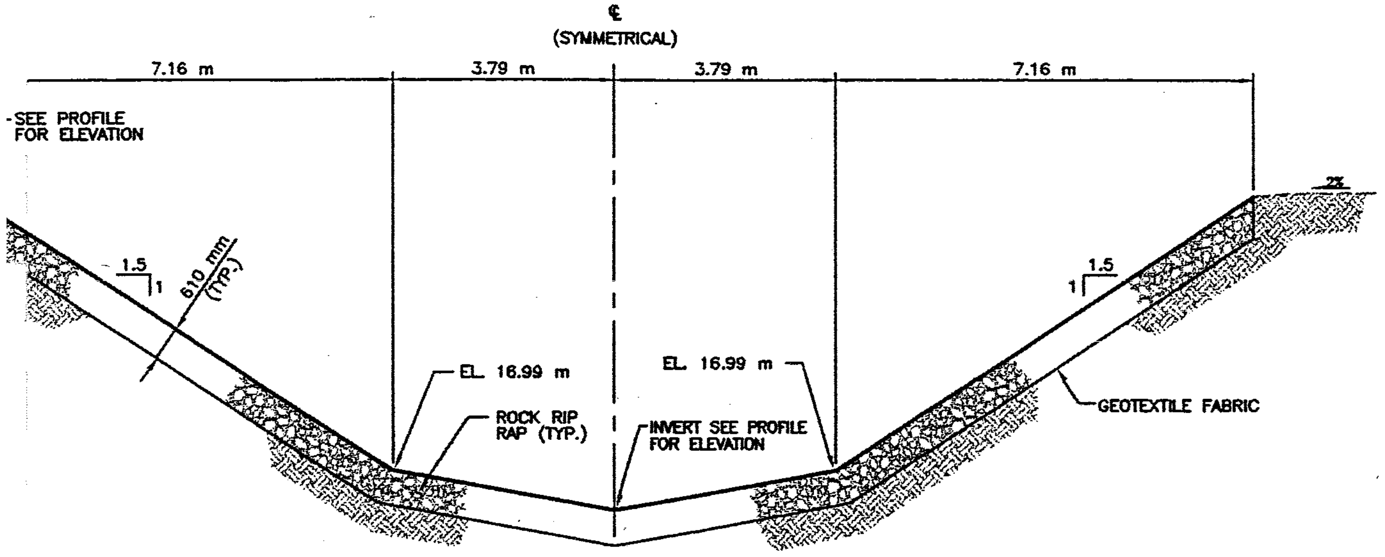
SCALE
1:100
SHEET



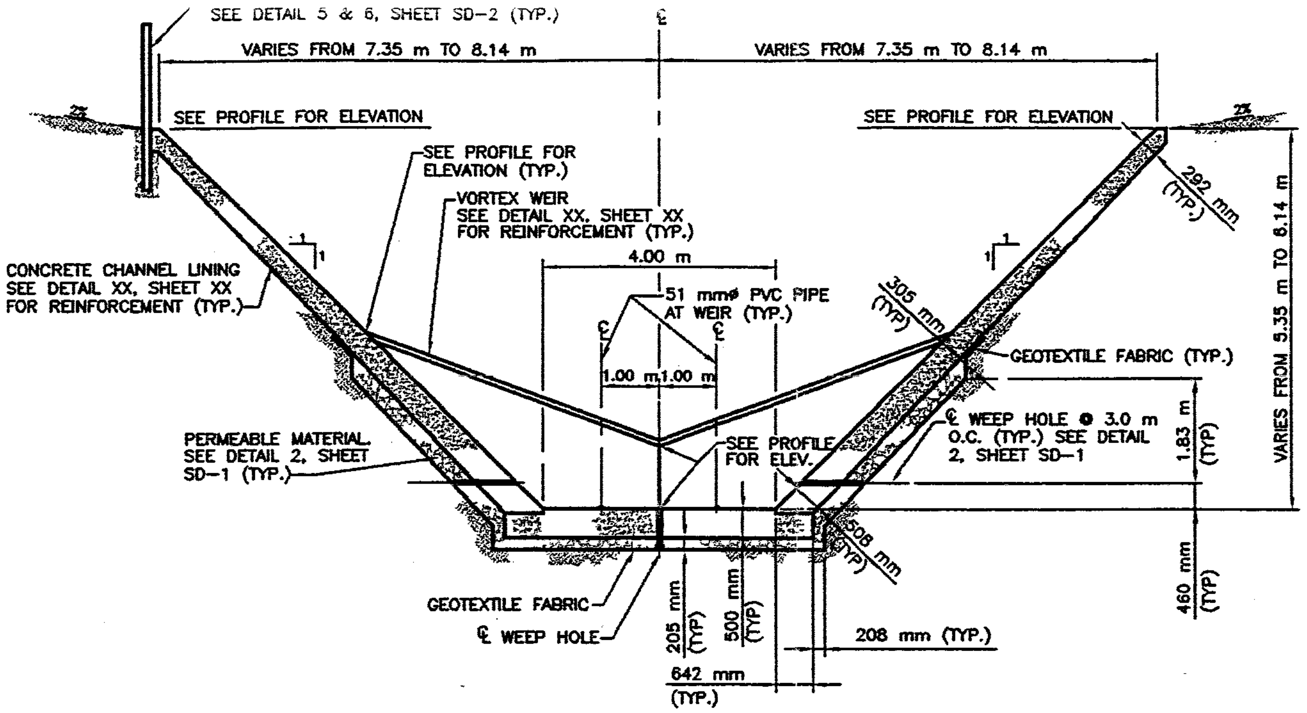
(1/5) **PROFILE – C-LINE**

HORIZ: 1:100
VERT: 1:50

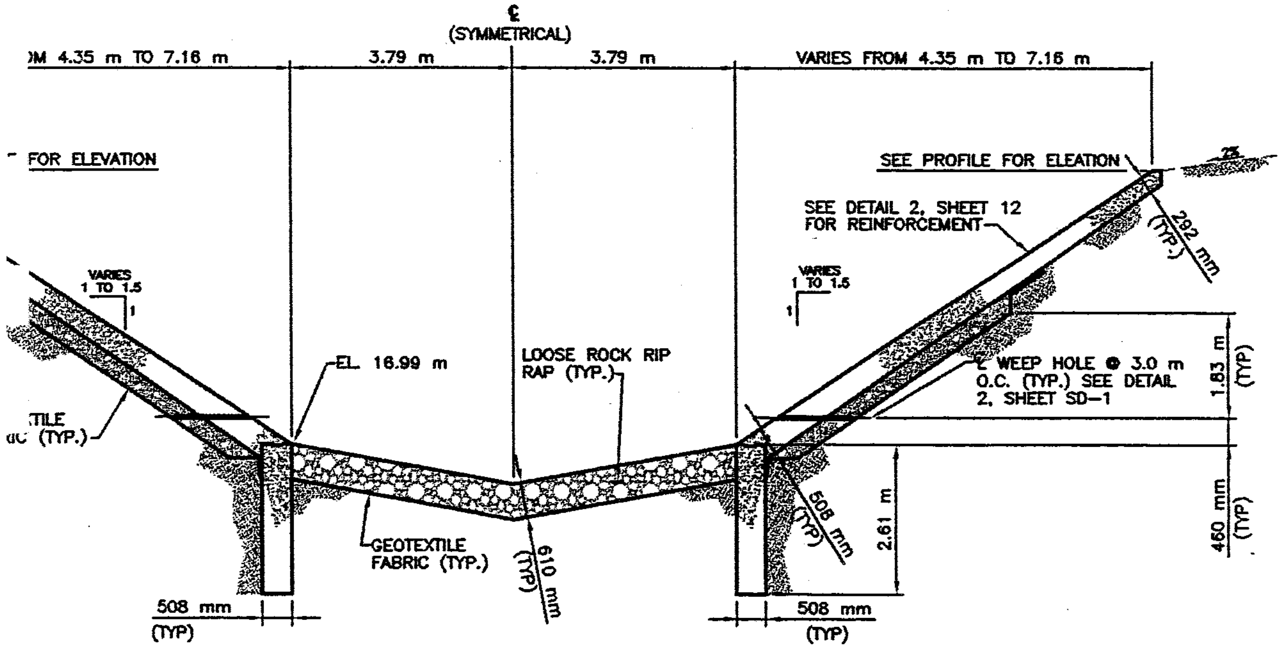
DATE	APPR	REFERENCE INFORMATION AND NOTES	DATE			VERIFY SCALES	SCALE
		1. TYPE CL-1.22 m FENCE TO BE INSTALLED ALONG VERTICAL CONCRETE WALL ON THE RIGHT (EAST) SIDE OF THE BANK. REFER TO DETAIL 5, SHEET SD-2. 2. A LOW-FLOW CHANNEL TO BE INSTALLED ALONG CENTER OF ROCK RIP RAP LINING	APRIL 2002 DESIGN	Santa Clara Valley Water District	STEVENS CREEK	0 25	AS SHOWN



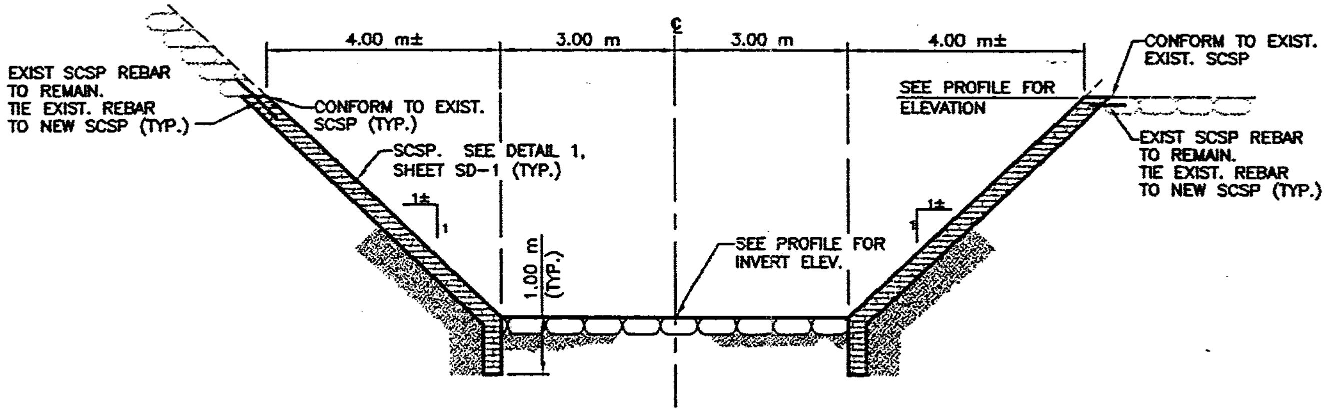
SECTION (A/9) **TYPICAL SECTION–LOOSE RIP RAP**
SCALE: 1:75 STA. 6+031.55 TO STA. 6+033.55


SEE DETAIL 5 & 6, SHEET SD-2 (TYP.)
℄
VARIES FROM 7.35 m TO 8.14 m
VARIES FROM 7.35 m TO 8.14 m
2%
SEE PROFILE FOR ELEVATION
SEE PROFILE FOR ELEVATION
2%
SEE PROFILE FOR ELEVATION (TYP.)
VORTEX WEIR SEE DETAIL XX, SHEET XX FOR REINFORCEMENT (TYP.)
292 mm (TYP.)
CONCRETE CHANNEL LINING SEE DETAIL XX, SHEET XX FOR REINFORCEMENT (TYP.)
1
1
4.00 m
51 mmø PVC PIPE AT WEIR (TYP.)
℄
℄
1
1
305 mm (TYP.)
GEOTEXTILE FABRIC (TYP.)
VARIES FROM 5.35 m TO 6.14 m
1.00 m
1.00 m
℄ WEEP HOLE @ 3.0 m O.C. (TYP.) SEE DETAIL 2, SHEET SD-1
1.83 m (TYP)
PERMEABLE MATERIAL. SEE DETAIL 2, SHEET SD-1 (TYP.)
SEE PROFILE FOR ELEV.
508 mm (TYP)
460 mm (TYP)
GEOTEXTILE FABRIC
℄ WEEP HOLE
205 mm (TYP)
500 mm (TYP)
208 mm (TYP.)
642 mm (TYP.)

SECTION (C/9) **TYPICAL SECTION–VORTEX WEIR**
SCALE: 1:75 STA. 6+001.77 TO STA. 6+025.80



SECTION (B/9) **TYPICAL SECTION–TRANSITIONAL WINGWALL**
SCALE: 1:75 STA. 6+025.80 TO STA. 6+031.55


4.00 m±
3.00 m
℄
3.00 m
4.00 m±
CONFORM TO EXIST. EXIST. SCSP
EXIST SCSP REBAR TO REMAIN. TIE EXIST. REBAR TO NEW SCSP (TYP.)
CONFORM TO EXIST. SCSP (TYP.)
SEE PROFILE FOR ELEVATION
SCSP. SEE DETAIL 1, SHEET SD-1 (TYP.)
EXIST SCSP REBAR TO REMAIN. TIE EXIST. REBAR TO NEW SCSP (TYP.)
1±
1
1±
1
1.00 m (TYP.)
SEE PROFILE FOR INVERT ELEV.

SECTION (D/9) **TYPICAL SECTION–SACK CONCRETE SLOPE PROTECTION**
SCALE: 1:75 STA. 5+999 TO STA. 6+000

	DATE	APPR	REFERENCE INFORMATION AND NOTES

GORDON M. LAU

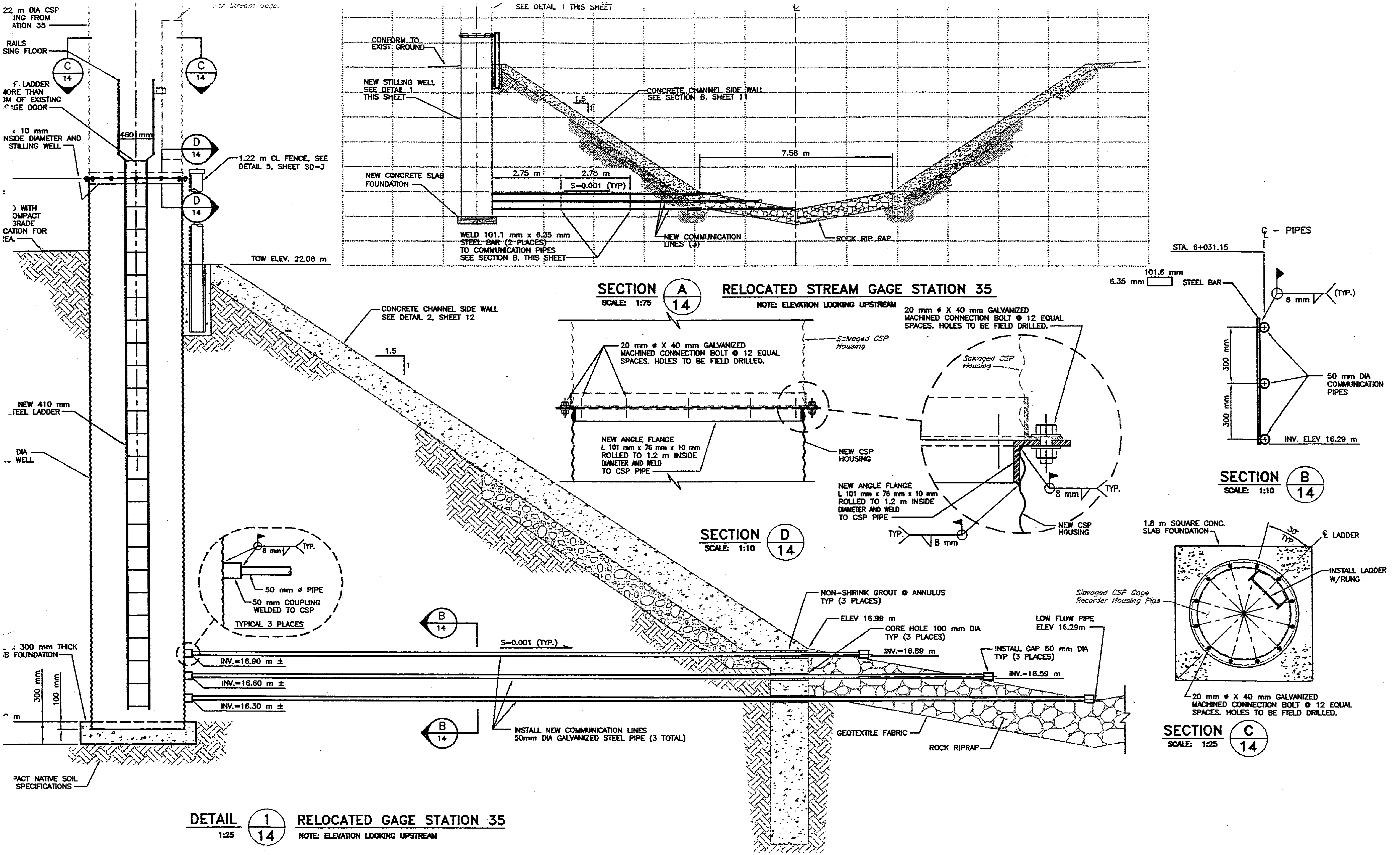
DATE
APRIL 2002
DESIGN
P.TAN

Santa Clara Valley Water District

STEVENS CREEK
DROP STRUCTURE MODIFICATION

VERIFY SCALES
0 25

SCALE
AS SHOWN



SECTION A/14 **RELOCATED STREAM GAGE STATION 35**
SCALE: 1:75
NOTE: ELEVATION LOOKING UPSTREAM

SECTION D/14
SCALE: 1:10

SECTION B/14
SCALE: 1:10

SECTION C/14
SCALE: 1:25

DETAIL 1/14 **RELOCATED GAGE STATION 35**
1:25
NOTE: ELEVATION LOOKING UPSTREAM

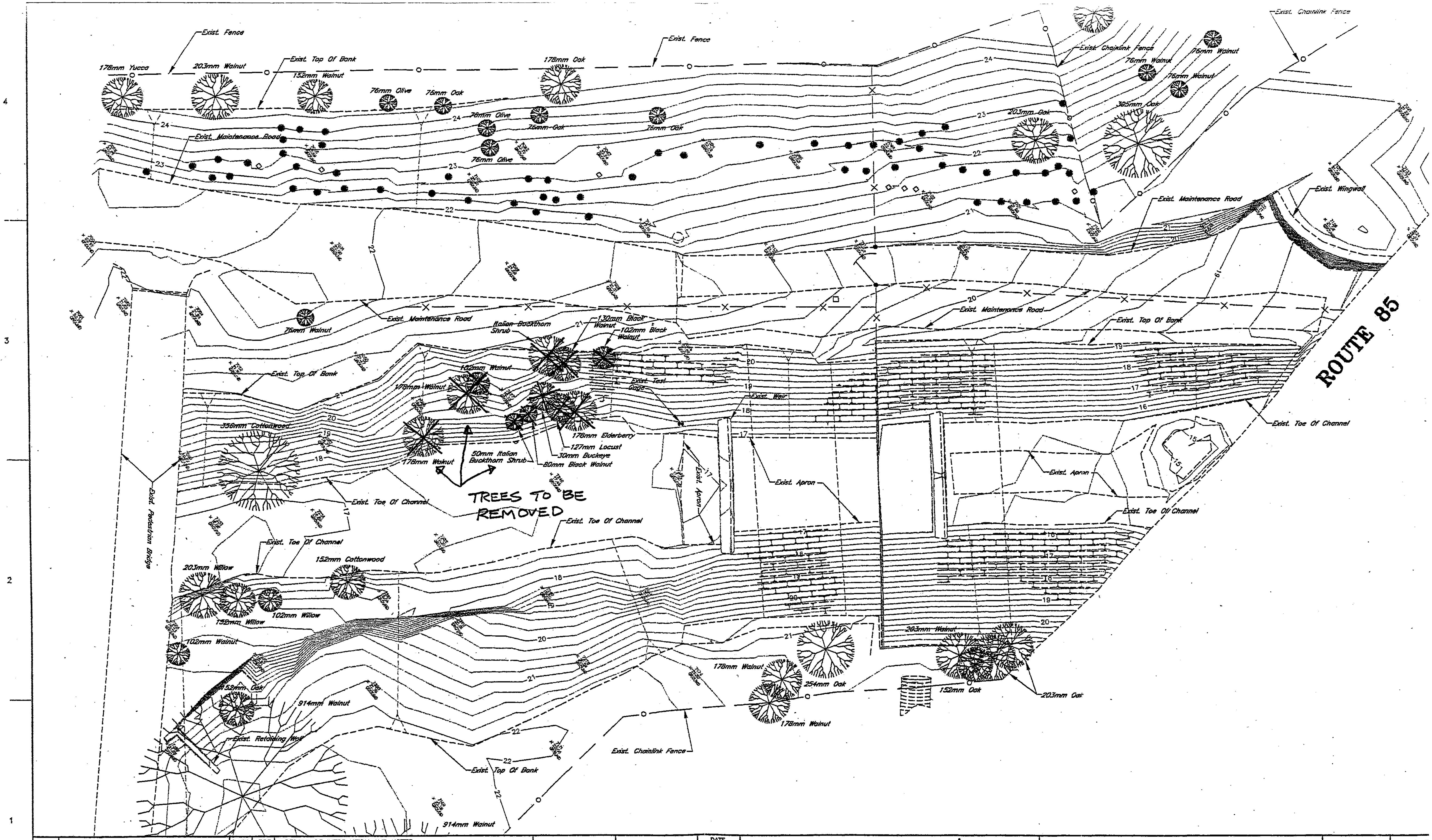
DATE	APPR	REFERENCE INFORMATION AND NOTES	DATE APRIL 2002 DESIGN	Santa Clara Valley Water District	STEVENS CREEK DROP STRUCTURE MODIFICATION	VERIFY SCALES 0 25	SCALE AS SHOWN

APPENDIX B

Preliminary Drawings and Sketches

B5 Concrete Horizontal Weir Alternative

(NOTE: These plans reflect a new weir design with a triangular notch. The hydraulic slope along the weirs and the plunge pool depth in the channel is less inclined and shallower, respectively, than what was originally shown on the preliminary plans that was sent to CDFG.)



REV	DESCRIPTION	DATE	APPR	REFERENCE INFORMATION AND NOTES

DATE
11/11/00
DESIGN
TI/BT
DRAWN
P.VU/CAM
CHECKED
G. LAU

Santa Clara Valley Water District

ENGINEERING CERTIFICATION

PROJECT ENGINEER R.C.E. NO.

ENGINEERING APPROVAL

SUPERVISING ENGINEER R.C.E. NO. XXXXX

STREAM GAGE STATION 35
ON STEVENS CREEK

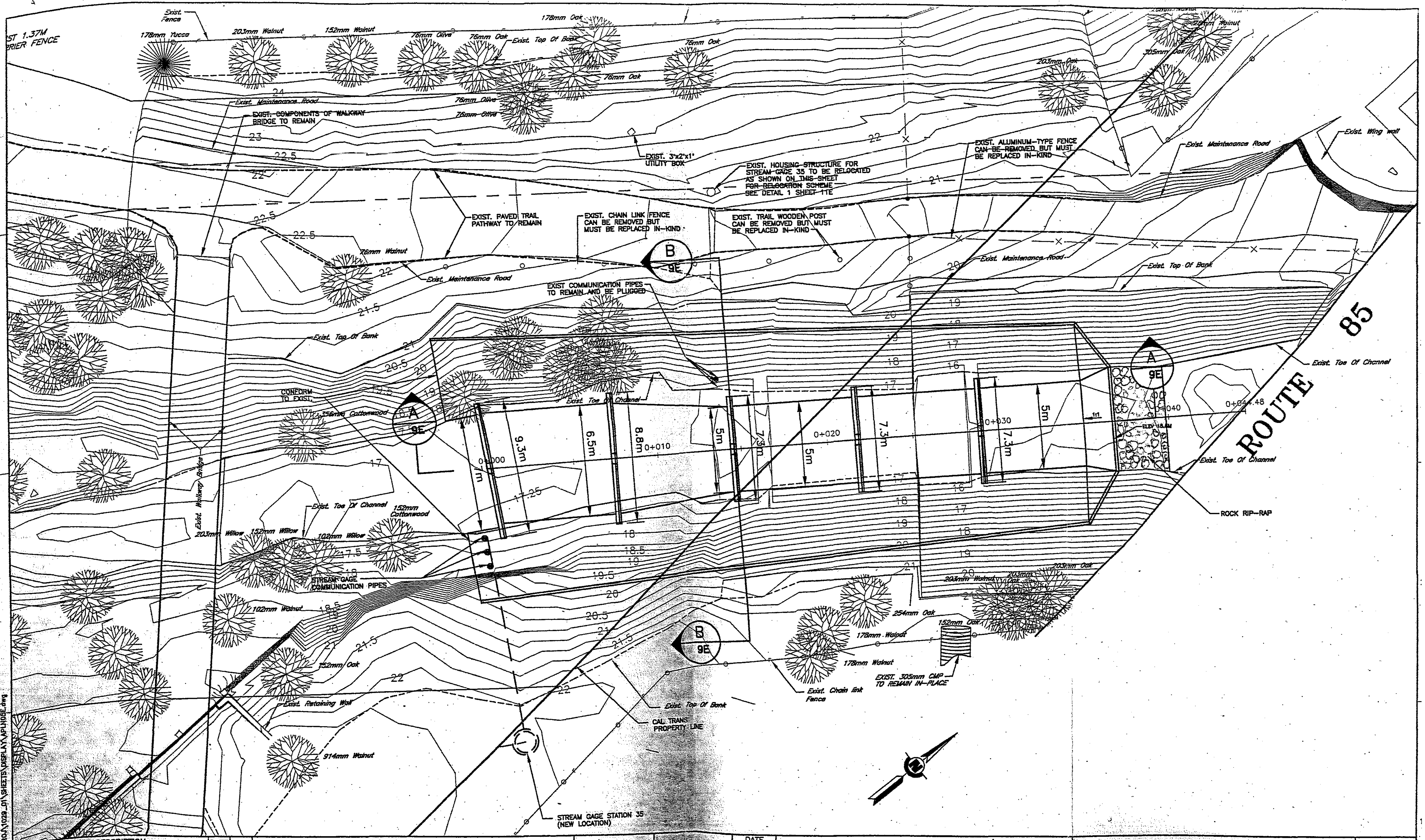
VERIFY SCALES
0 25
BAR IS 25 MILLIMETERS ON ORIGINAL DRAWING IF NOT ADJUST SCALES ACCORDINGLY

SCALE
1:100

SHEET

OF

G:\DWGS\SDSKPROJ\1025_01\SHEETS\SHT_005.DWG 9-25-99 11:15:33 AM EST



G:\DWGS\SDSKPROJ\1029_01\SHEETS\DISPLAY\APLN05E.dwg

REV	DESCRIPTION	DATE	APPR	REFERENCE INFORMATION AND NOTES

DATE 7/13/01
DESIGN
DRAWN P.VU/CAM
CHECKED

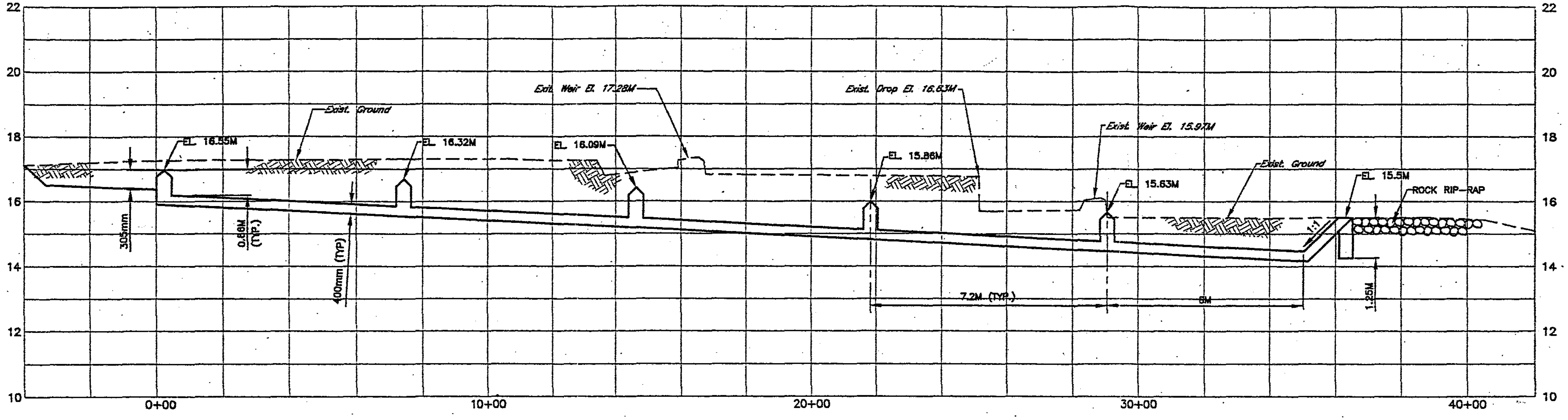
Santa Clara Valley Water District

CERIFICATION
PROJECT ENGINEER R.C.E. NO. XXXXX

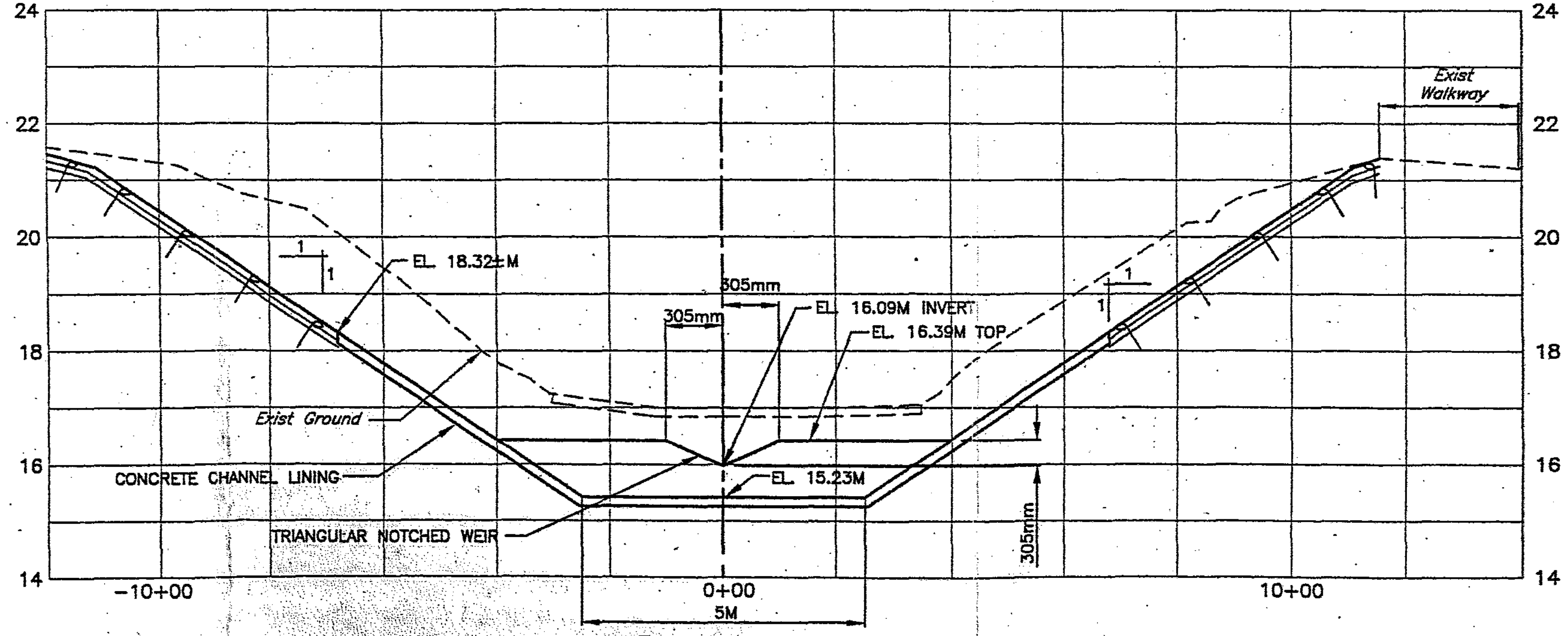
APPROVAL
SUPERVISING ENGINEER R.C.E. NO. XXXXX

STEVENS CREEK
DROP STRUCTURE MODIFICATION UPSTREAM OF HIGHWAY 85
SITE PLAN

SCALE 1:200
SHEET
5E
1 OF 3



A / 9E **SECTION**
SCALE: NTS



B / 9E **SECTION**
SCALE: NTS

REV	DESCRIPTION	DATE	APPR

REFERENCE INFORMATION AND NOTES

1. UNLESS OTHERWISE NOTED, CONCRETE COVER REINFORCEMENT TO BE 75mm MIN.
2. YIELD STRENGTHS;
   - fy = 400,000 kpa MIN. STEEL
   - fc = 20,700 kpa MIN. CONCRETE.
3. ALL BAR SIZE DESIGNATIONS DRAWN ARE IN METRIC.

DATE 7/13/01
DESIGN B. T./T. I.
DRAWN P.VU/CAM
CHECKED G. LAU

Santa Clara Valley Water District

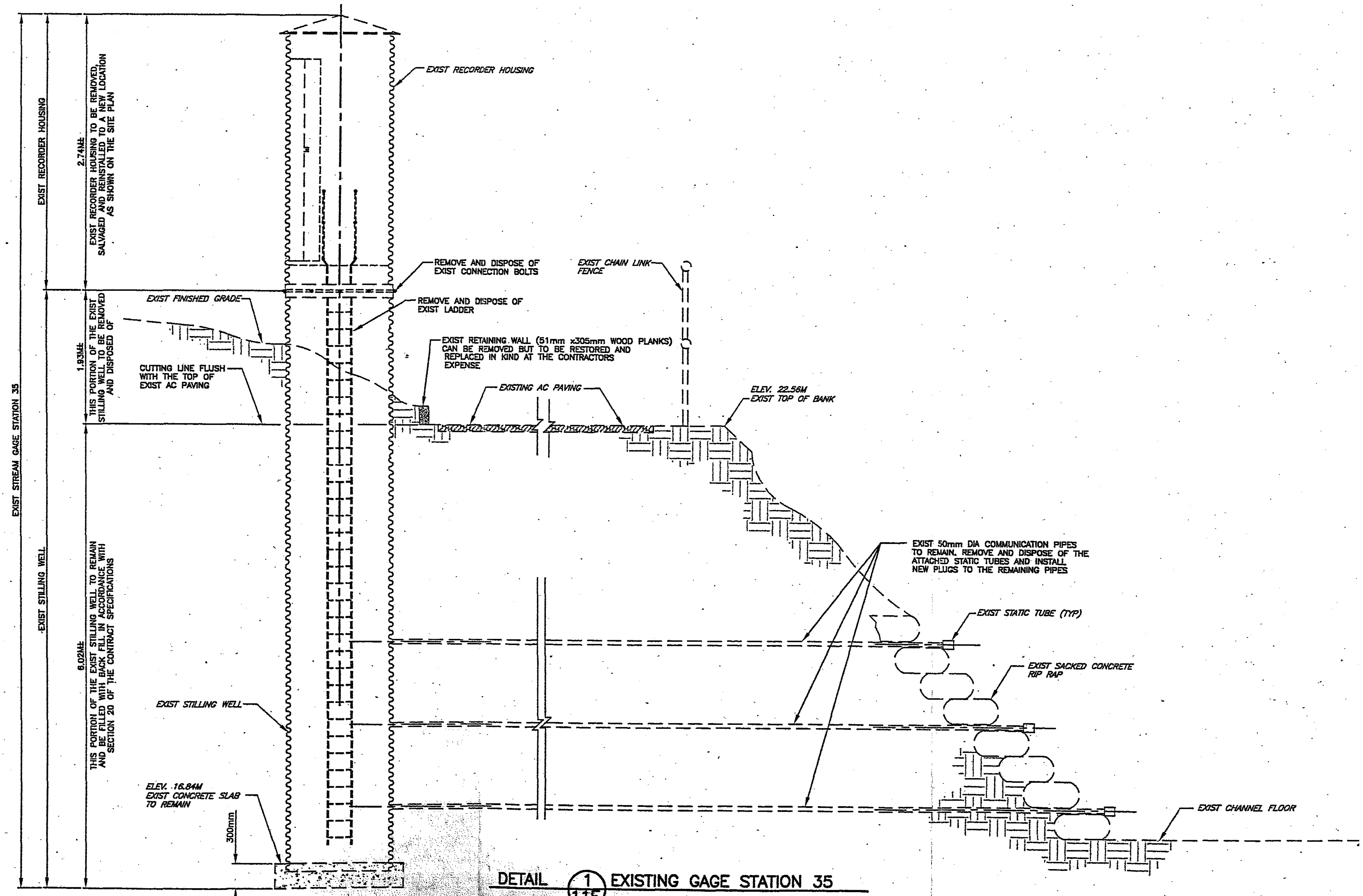
ENGINEERING CERTIFICATION
PROJECT ENGINEER R.C.E. NO. XXXXX

ENGINEERING APPROVAL
SUPERVISING ENGINEER R.C.E. NO. XXXXX

STEVENS CREEK
DROP STRUCTURE MODIFICATION
UPSTREAM OF HIGHWAY 85
DETAILS AND SECTIONS

VERIFY SCALES
0 25
BAR IS 25 MILLIMETERS ON ORIGINAL DRAWING IF NOT ADJUST SCALES ACCORDINGLY

SCALE AS SHOWN
SHEET
9E
2 OF 3


EXIST STREAM GAGE STATION 35
EXIST RECORDER HOUSING
EXIST STILLING WELL
2.74M±
EXIST RECORDER HOUSING TO BE REMOVED, SALVAGED AND REINSTALLED TO A NEW LOCATION AS SHOWN ON THE SITE PLAN
1.93M±
THIS PORTION OF THE EXIST STILLING WELL TO BE REMOVED AND DISPOSED OF
6.02M±
THIS PORTION OF THE EXIST STILLING WELL TO REMAIN AND BE FILLED WITH BACK FILL IN ACCORDANCE WITH SECTION 20 OF THE CONTRACT SPECIFICATIONS
EXIST RECORDER HOUSING
REMOVE AND DISPOSE OF EXIST CONNECTION BOLTS
EXIST CHAIN LINK FENCE
EXIST FINISHED GRADE
REMOVE AND DISPOSE OF EXIST LADDER
EXIST RETAINING WALL (51mm x305mm WOOD PLANKS) CAN BE REMOVED BUT TO BE RESTORED AND REPLACED IN KIND AT THE CONTRACTORS EXPENSE
CUTTING LINE FLUSH WITH THE TOP OF EXIST AC PAVING
EXISTING AC PAVING
ELEV. 22.56M
EXIST TOP OF BANK
EXIST 50mm DIA COMMUNICATION PIPES TO REMAIN. REMOVE AND DISPOSE OF THE ATTACHED STATIC TUBES AND INSTALL NEW PLUGS TO THE REMAINING PIPES
EXIST STATIC TUBE (TYP)
EXIST SACKED CONCRETE RIP RAP
EXIST STILLING WELL
ELEV. 16.84M
EXIST CONCRETE SLAB TO REMAIN
300mm
EXIST CHANNEL FLOOR

DETAIL ① 11E **EXISTING GAGE STATION 35**

NTS

NOTE: ELEVATION LOOKING DOWNSTREAM

REV.	DESCRIPTION	DATE	APPR	REFERENCE INFORMATION AND NOTES

DATE 7/11/01
DESIGN R.MARIANO
DRAWN P.VU/CAM
CHECKED

Santa Clara Valley Water District

PROJECT ENGINEER R.C.E. NO. XXXXX

STEVENS CREEK
DROP STRUCTURE MODIFICATION
UPSTREAM OF HIGHWAY 85
STREAM GAGE STATION 35 RELOCATION
RELOCATION SCHEME

VERIFY SCALES
0 25
BAR IS 25 MILLIMETERS ON ORIGINAL DRAWING IF NOT ADJUST

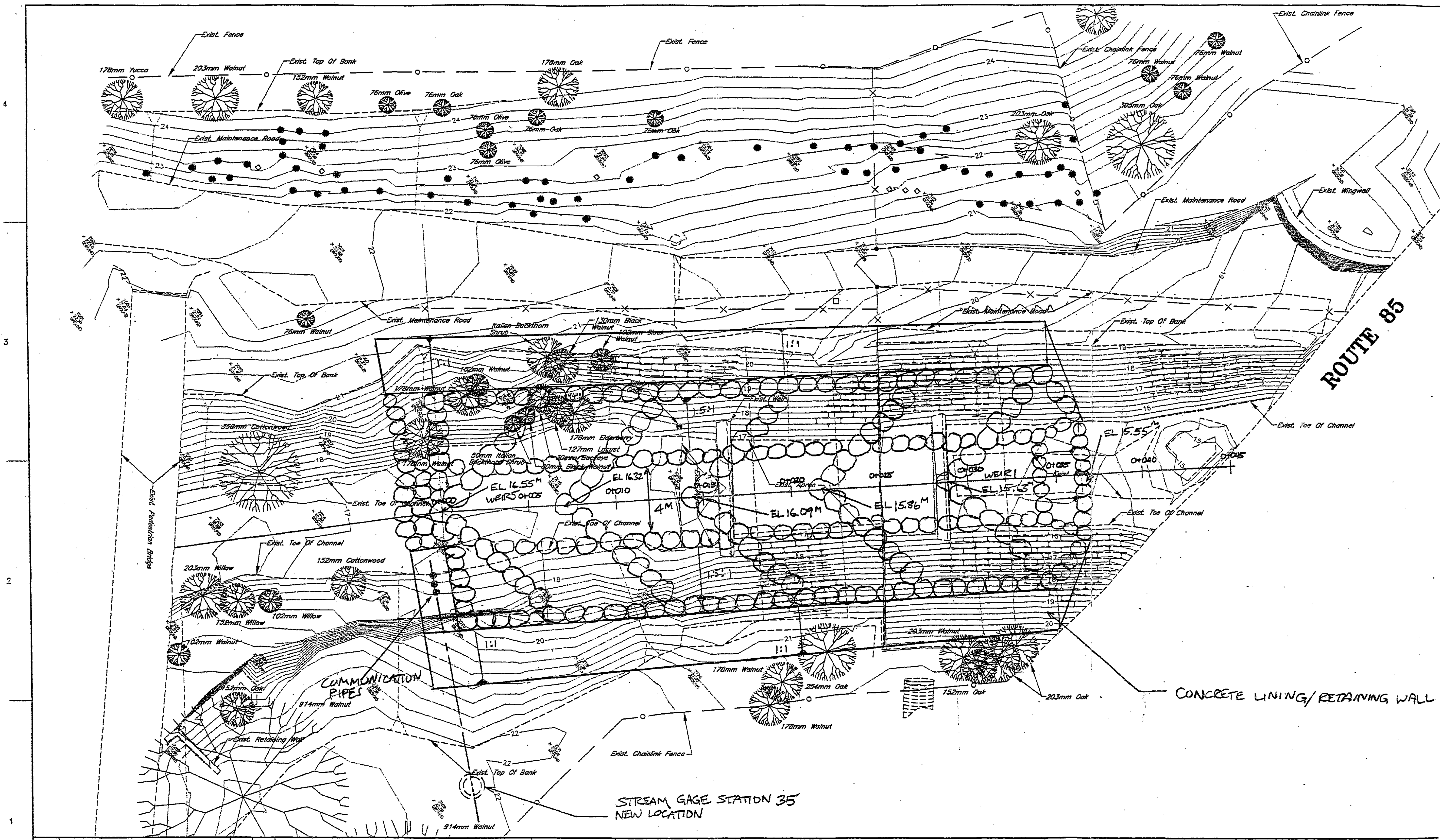
SCALE AS SHOWN

SHEET 11E

APPENDIX B

Preliminary Drawings and Sketches

B6 Boulder Weir Retaining Wall Alternative



REV	DESCRIPTION	DATE	APPR	REFERENCE INFORMATION AND NOTES

REGISTERED PROFESSIONAL ENGINEER
TED J. IBARRA
No. 52387
Exp. 12/31/98
CIVIL
STATE OF CALIFORNIA

DATE	11/11/00
DESIGN	TI/BT
DRAWN	P.VU/CAM
CHECKED	G. LAU

Santa Clara Valley Water District

ENGINEERING CERTIFICATION	ENGINEERING APPROVAL
PROJECT ENGINEER R.C.E. NO. 52387	SUPERVISING ENGINEER R.C.E. NO. XXXXX

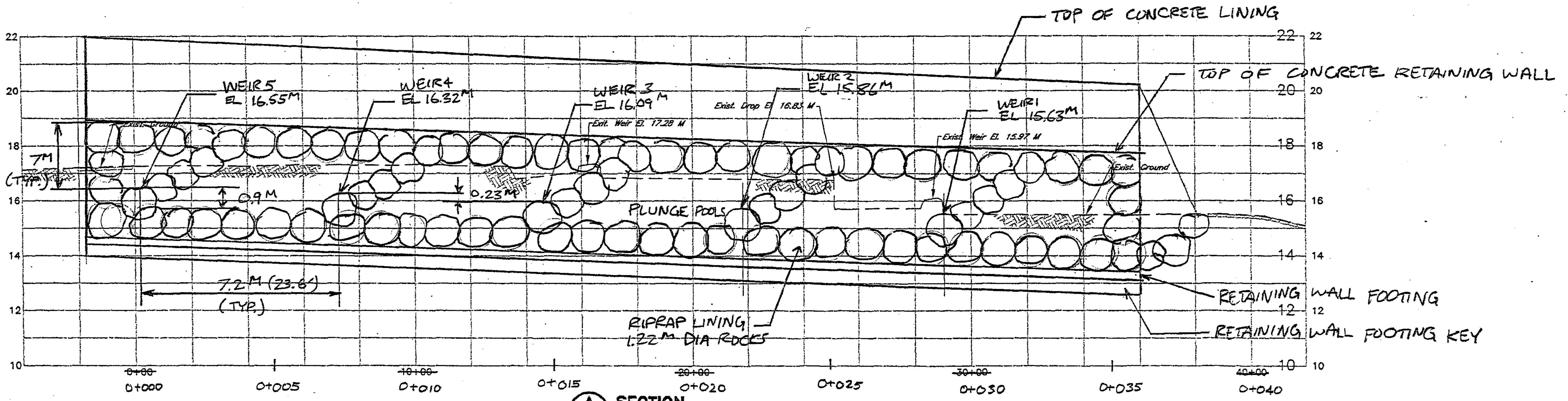
FISH LADDER AND RELOCATION
OF STREAM GAGE STATION 35
ON STEVENS CREEK

PLANNNG

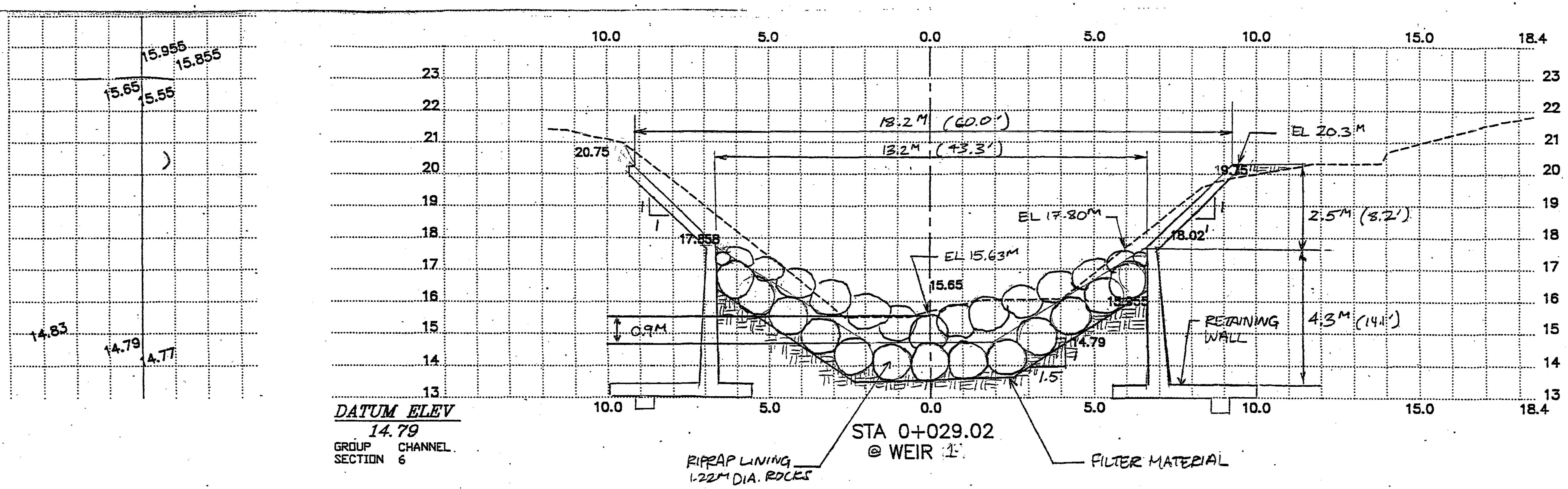
VERIFY SCALES
0 25
BAR IS 25 MILLIMETERS ON ORIGINAL DRAWING IF NOT ADJUST SCALES ACCORDINGLY

SCALE 1:100
SHEET
P1
OF X

G:\DWGS\SDSKPROJ\1025_01\SHEETS\SHT_005.DWG 9-29-99 11:16:33 AM EST

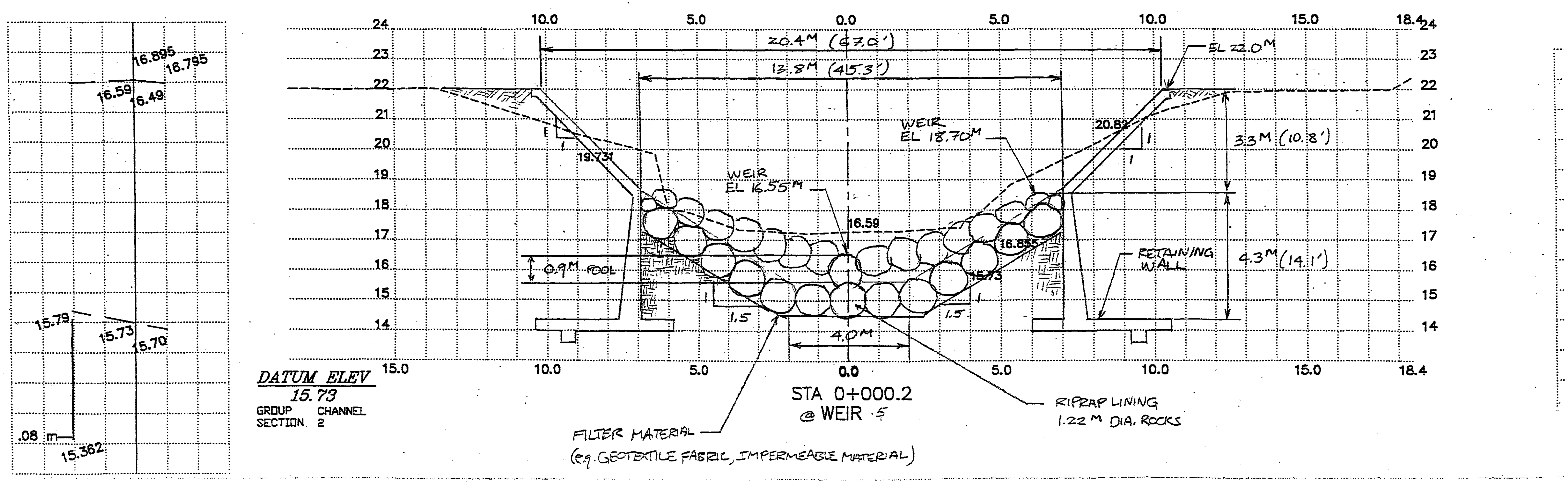

TOP OF CONCRETE LINING
TOP OF CONCRETE RETAINING WALL
WEIR 5
EL 16.55M
WEIR4
EL 16.32M
WEIR 3
EL 16.09M
WEIR 2
EL 15.86M
WEIR1
EL 15.63M
Exist. Drop El 16.83 M
Exit. Weir El. 17.28 M
Exist. Weir El. 15.97 M
Exist. Ground
Exist. Ground
7M
(TYP.)
0.9M
0.23M
PLUNGE POOLS
7.2M (23.6')
(TYP.)
RIPRAP LINING
1.22M DIA ROCKS
RETAINING WALL FOOTING
RETAINING WALL FOOTING KEY
22
20
18
16
14
12
10
~~0+00~~
0+000
0+005
~~10+00~~
0+010
0+015
~~20+00~~
0+020
0+025
~~30+00~~
0+030
0+035
~~40+00~~
0+040

A
8
SECTION



DATUM ELEV
14.79
GROUP CHANNEL
SECTION 6

STA 0+029.02
@ WEIR 1



DATUM ELEV
15.73
GROUP CHANNEL
SECTION 2

STA 0+000.2
@ WEIR 5

APPENDIX C

Cost Estimates

TABLE 1

CONSTRUCTION COST FOR PROPOSED PROJECTS

Construction Cost Items for Various Alternatives		Alternative No. 1 No Project	Alternative No. 2 Denil Fish Ladder			Alternative No. 3 Vortex Rock Weir			Alternative No. 4 Concrete Vortex Weir			Alternative No. 4(a) Refined Concrete Vortex Weir			Alternative No. 5 Concrete Horizontal Weir			Alternative No. 6 Boulder Weir and Retaining Wall		
Item No.	Item Description	Amount	Quantities	Unit Price	Amount	Quantities	Unit Price	Amount	Quantities	Unit Price	Amount	Quantities	Unit Price	Amount	Quantities	Unit Price	Amount	Quantities	Unit Price	Amount
1	Storm Water Pollution Prevention Plan (SWPPP)	--	1	LS	$30,000	1	LS	$65,000	1	LS	$65,000	1	LS	$65,000	1	LS	$65,000	1	LS	$65,000
2	Mobilization (incl. Access Road & Restoration)	--	1	LS	$100,000	1	LS	$100,000	1	LS	$100,000	1	LS	$100,000	1	LS	$100,000	1	LS	$100,000
3	Clearing and Grubbing	--	--	--	n/a	1	LS	$30,000	1	LS	$30,000	1	LS	$30,000	1	LS	$30,000	1	LS	$40,000
4	Control of Water	--	1	LS	$15,000	1	LS	$45,000	1	LS	$45,000	1	LS	$45,000	1	LS	$45,000	1	LS	$50,000
5	Concrete Removal	--	550	100/CY	$55,000	1060	100/CY	$106,000	1060	100/CY	$106,000	1060	100/CY	$106,000	1060	100/CY	$106,000	1060	100/CY	$106,000
6	Channel Excavation (incl. Shoring)	--	600	100/CY	$60,000	1400	100/CY	$140,000	950	100/CY	$95,000	750	100/CY	$75,000	800	100/CY	$80,000	3500	50/CY	$175,000
7	Channel Embankment (incl. Backfill)	--	--	--	n/a	--	--	n/a	310	250/CY	$77,500	250	250/CY	$62,500	350	250/CY	$87,500	2700	100/CY	$270,000
8	Structural Concrete (incl. Weep Holes, Fabric, Etc.	--	320	1000/CY	$320,000	--	--	n/a	300	1000/CY	$300,000	240	1000/CY	$240,000	280	1000/CY	$280,000	600	1100/CY	$660,000
9	Planting of Trees	--	2	500/EA	$1,000	1	LS	$80,000	1	LS	$15,000	1	LS	$10,000	1	LS	$15,000	11	600/EA	$6,600
10	Landscape Restoration		--	--	n/a	1	LS	$10,000	1	LS	$10,000	1	LS	$10,000	1	LS	$10,000	1	LS	$10,000
11	Denil Fishway	--	1	LS	$20,000	--	--	n/a	--	--	n/a	--	--	n/a	--	--	n/a	--	--	n/a
12	Rock Channel Protection (incl. Weirs & Lining)	--	--	--	n/a	1300	100/TON	$130,000	--	--	n/a	75	100/TON	$7,500	--	--	n/a	2500	100/TON	$250,000
13	Relocation of Gage Station	--	1	LS	$20,000	1	LS	$20,000	1	LS	$20,000	1	LS	$20,000	1	LS	$20,000	1	LS	$50,000
14	Relocated Concrete Weir Dam Foundation	--	--	--	n/a	1	LS	$178,000	--	--	n/a	--	--	n/a	--	--	n/a	--	--	n/a
15	Public Safety Measure (incl. Temporary Fencing)	--	1	LS	$5,000	1	LS	$5,000	1	LS	$5,000	1	LS	$5,000	1	LS	$5,000	1	LS	$10,000
16	Permanent Chain Link Fence (4-ft)		125	50/LF	$6,250	125	50/LF	$6,250	125	50/LF	$6,250	125	50/LF	$6,250	125	50/LF	$6,250	125	50/LF	$6,250
17	Anchoring of Rocks	--	--	--	n/a	1	LS	$20,000	--	--	n/a	--	--	n/a	--	--	n/a	--	--	n/a
18	Extra Work (5% of Total Cost)				$37,000			$55,000			$51,000			$45,750	1		$50,000	1	LS	$105,000
Subtotal of all cost items		n/a			$669,250			$990,250			$925,750			$828,000			$899,750			$1,903,850
Contingencies for construction (10%)		n/a			$66,925			$99,025			$92,575			$82,800			$89,975			$190,385
Total construction cost (4/12/02)		n/a			$736,175			$1,089,275			$1,018,325			$910,800			$989,725			$2,094,235
(NOTE: Some cost items for various alternatives are not shown because it is already included in the other cost items.)		Zero construction cost (see Table 2 for annual maintenance cost)	Based on Year 2002 cost, approximately		**$740,000**	Based on Year 2002 cost, approximately		**$1,100,000**	Based on Year 2002 cost, approximately		**$1,020,000**	Based on Year 2002 cost, approximately		**$915,000**	Based on Year 2002 cost, approximately		**$1,000,000**	Based on Year 2002 cost, approximately		**$2,100,000**

TABLE 2

TOTAL PROJECT COST COMPARISON

	Alternative No.1 No Project	Alternative No.2 Denil Fish Ladder	Alternative No.3 Vortex Rock Weir	Alternative No.4 Concrete Vortex Weir	Alternative No.4(a) Refined Concrete Vortex Weir	Alternative No.5 Concrete Horizontal Weir	Alternative No.6 Boulder Weir and Retaining Wall
Construction Cost	n/a	$740,000	$1,100,000	$1,020,000	$915,000	$1,000,000	$2,100,000
Project Management*	n/a	$110,000	$110,000	$110,000	$110,000	$110,000	$110,000
Planning*	n/a	$80,000	$80,000	$80,000	$80,000	$80,000	$80,000
CEQA & Envn. Permits*	n/a	$120,000	$120,000	$120,000	$120,000	$120,000	$120,000
Design Engineering*	n/a	$145,200	$181,500	$181,500	$181,500	$181,500	$181,500
Right of Way*	n/a	$50,000	$95,000	$50,000	$50,000	$50,000	$50,000
Construction Support*	n/a	$150,000	$150,000	$150,000	$150,000	$150,000	$150,000
TOTAL PROJECT COST	**Zero project cost but annual maintenance cost still applies**	**$1,395,200**	**$1,836,500**	**$1,711,500**	**$1,606,500**	**$1,691,500**	**$2,791,500**
Annual maintenance cost[1]	$5,000	$15,000	$5,000	$5,000	$5,000	$5,000	$5,000

NOTES:

--*These costs were obtained from the current project resources schedule and it entails labor hours needed for each specific task.

--[1]This cost was provided by the Watershed Technical Support Unit and is not included in the total project cost shown above. All alternatives requires the $5,000 per year estimate for inspections and debris removal if required. The rock weir alternative may have costs higher than $5,000 due to an unforeseeable event, such as boulder separation and repositioning it. The Denil fish ladder alternative includes an additional $10,000 for maintenance work twice in a year consisting of cleaning the fishway and vacuuming. This figure is based on estimated costs to maintain existing Denil fish ladders along Stevens Creek.